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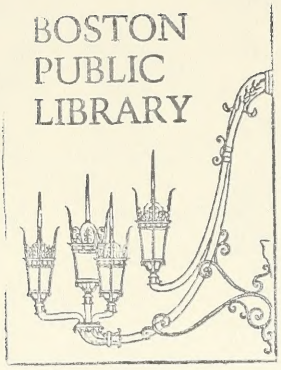
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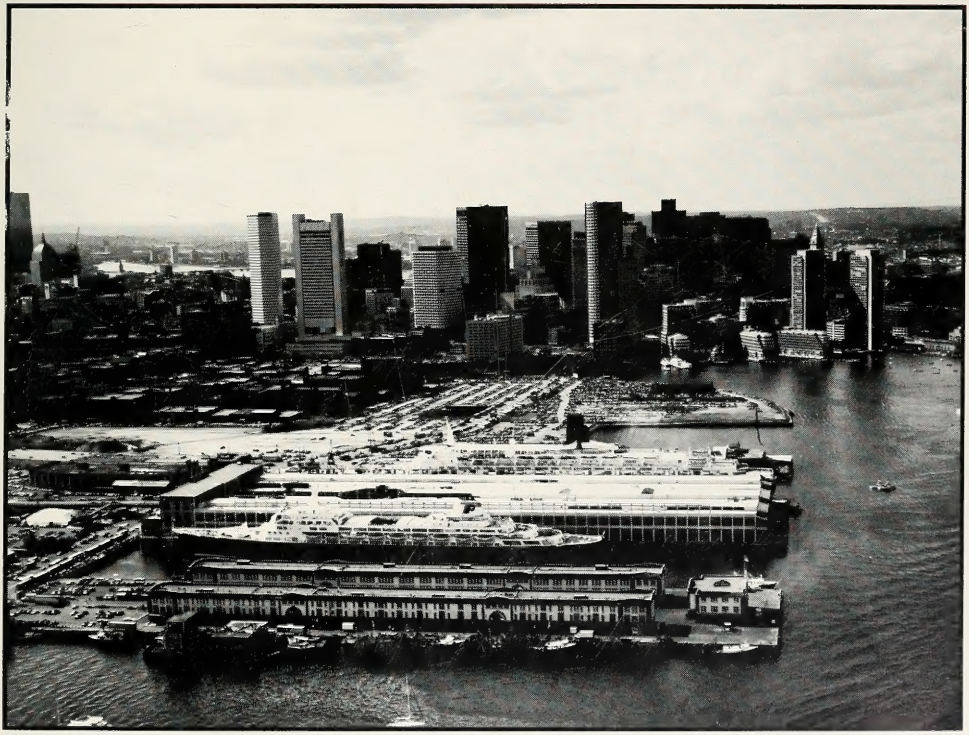

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SOUTH BOSTON PIERS/FORT POINT CHANNEL TRANSIT PROJECT

BOSTON, MASSACHUSETTS

FINAL ENVIRONMENTAL IMPACT STATEMENT/ FINAL ENVIRONMENTAL IMPACT REPORT

Submitted Pursuant to the National Environmental Policy Act
42 U.S.C. 4332 (2) (c) 77

and in Accordance with the Massachusetts Environmental Policy Act
M.G.L. Ch. 30 Sec. 61, 62-62H

by the

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL TRANSIT ADMINISTRATION

and the

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

12/10/93

Date of Approval

For FTA, Mr. Richard Doyle
Federal Transit Administration — Region I
U.S. Department of Transportation
55 Broadway, Kendall Square, 9th floor
Cambridge, MA 02142

12/2/93

Date of Approval

For MBTA, Mr. John J. Haley, Jr.
General Manager
Massachusetts Bay Transportation Authority
Ten Park Plaza
Boston, MA 02116

Abstract

The Federal Transit Administration and the Massachusetts Bay Transportation Authority have prepared this Final Environmental Impact Statement/Final Environmental Impact Report (FEIS/FEIR) for proposed transit improvements to the South Boston Piers area and portions of downtown Boston. The South Boston portion of the study area is bounded on the west by Fort Point Channel, to the south by Fargo and Summer Streets, to the east by the Reserved Channel and Boston Marine Industrial Park, and on the north by Boston Harbor. The downtown portion of the project study area is bounded to the west by Tremont and Boylston Streets, to the south by Marginal Road and Kneeland Street, to the east by the Fort Point Channel, and to the north by Atlantic Avenue starting at New Northern Avenue and extending into the periphery of the Downtown Crossing/Summer Street shopping district. The FEIS/FEIR is prepared in conformance with 40 CFR Part 1500, Council on Environmental Quality Regulations for Implementing the Procedural Requirements of the National Environmental Policy Act of 1969, as amended; and 49 CFR Part 622, Federal Highway Administration and Federal Transit Administration, Environmental Impact and Related Procedures. It also meets the requirements of the Massachusetts Environmental Policy Act and its associated regulations, 301 CMR 10.00.

Impacts analyzed include changes in the natural environment (air quality, noise, vibration, water quality, energy, and aesthetics), changes in the social environment (land use, traffic, development, and neighborhoods), changes to parklands and historic sites, changes in transit service and patronage, associated changes in highway congestion, capital costs, operating and maintenance costs, and financial implications. Impacts are identified both for the construction period and for the long-term operation of the alternatives.

The evaluation criteria include transportation, environmental, social, economic, and financial measures as required by current federal and state environmental laws and current Council on Environmental Quality and Federal Transit Administration guidelines.

Comments on this document or requests for information may be submitted in writing to ***Ms. Nancy T. Polcari*** of the Massachusetts Bay Transportation Authority and/or Ms. Mary Beth Mello of the Federal Transit Administration at the above-mentioned addresses.

SOUTH BOSTON PIERS/FORT POINT CHANNEL TRANSIT PROJECT

FINAL ENVIRONMENTAL IMPACT STATEMENT/FINAL ENVIRONMENTAL IMPACT REPORT

Preface

This Final Environmental Impact Statement/Final Environmental Impact Report (FEIS/FEIR) is prepared in compliance with the National Environmental Policy Act and the Massachusetts Environmental Policy Act. Organization of the report is in accordance with the guidelines of the Federal Transit Administration (FTA).

The Federal-State Relationship in the FEIS/FEIR

The preparation of an environmental impact statement/report is governed under both state and federal law. The two sets of laws and regulations are similar in their basic intent but differ in their emphasis. The state process is regulated by the Massachusetts Environmental Policy Act (MEPA) Unit of the state Executive Office of Environmental Affairs (EOEA). The primary emphasis of the state process is to assess the full range of environmental impacts of a proposed project; these impacts are documented in an Environmental Impact Report (EIR). The federal process, as described in Council on Environmental Quality and FTA guidelines, requires the assessment of the environmental consequences, transportation benefits, and costs associated with alternative courses of action. Documentation of such impacts, benefits, and costs is provided in a federal Environmental Impact Statement (EIS). The state process stresses the analysis of environmental impacts and the examination of alternatives that meet project goals and objectives while minimizing negative environmental consequences. The federal process also insists on examination of alternatives that address the same basic transportation problems at less cost. The FEIS/FEIR is intended to satisfy both MEPA and National Environmental Protection Act (NEPA) requirements.

Project History

The state process for the project was initiated by the Massachusetts Bay Transportation Authority (MBTA) in the spring of 1987 with a four-month feasibility study[1] that provided a preliminary evaluation of new public transit service alternatives to meet the travel demands of future development in the South Boston Piers/Fort Point Channel area. Ideas on potential additional transit services were solicited from a wide range of consultants, interested parties, and local agencies, including the Massachusetts Port Authority, Massachusetts Highway Department (formerly the Massachusetts Department of Public Works), Boston Transportation Department, and Boston Redevelopment Authority. In addition, the study developed transit alternatives that had been proposed by private developers. The participants in the study reached a consensus that any new service must emphasize connections to current MBTA rail lines to provide service to as many regional corridors as possible with minimum transfers.

Based on agency suggestions, public involvement, and analysis by the study team, alternatives were categorized by distinct linkages from the Piers area to existing or projected transit resources. The possibilities included various transit technology, destination, and alignment options. From the approximately 250 logical combinations that could be formed from these options, six alternatives were identified for further analysis. These alternatives included conventional surface bus service, two elevated and one underground

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[1] Massachusetts Bay Transportation Authority. *South Boston Piers/Fort Point Channel Transit Feasibility Study*. Prepared by URS Corporation. June 1987.

people mover alignments, elevated guided bus, and a relocated Red Line.

Concurrent with preparation of the feasibility study, city officials and private citizens began the process of formalizing a plan to guide future development of the Piers area. Under the planning leadership of the Boston Redevelopment Authority and with significant input from the Fort Point Channel Citizens Advisory Committee and the Mayor's Office of Neighborhood Services, the Fort Point Channel District Plan[2] was drafted in June 1987. The plan determined that the development plans and economic revitalization of the Piers area hinged in part on substantially improved access, including a major investment in new public transportation. The feasibility study echoed these conclusions and recommended that a formal environmental impact analysis be initiated to enable a comprehensive evaluation of viable alternatives.

A *Draft Environmental Impact Report* (DEIR)[3] was initiated in the fall of 1987 pursuant to the requirements of the Massachusetts Environmental Policy Act. The DEIR was intended to provide a conceptual analysis of various long-term approaches for the extension of transit service to the South Boston Piers area. As the first step in the state scoping process, an Environmental Notification Form (ENF) for the project was noticed in the *Environmental Monitor* on November 12, 1987, and two state scoping meetings were held on December 10, 1987 at the Federal Reserve Bank in Boston. At the conclusion of this state scoping process, the Secretary of the Massachusetts Executive Office of Environmental Affairs issued a certificate directing the MBTA to prepare a DEIR analyzing seven alternatives, two of which — the Elevated People Mover and the South Station/South Boston Rail Shuttle — were eliminated in the early phases of the DEIR due to urban design and operational problems. The following five alternatives were analyzed in terms of effectiveness (the extent to which each alternative achieves the goals of the project), environmental impacts, financial feasibility, and cost-effectiveness:

1. **No Action**: Incremental increases in current bus routes.

2. **Bus/TSM**: High frequency shuttle bus service from South Station, Park Square, and North Station to the South Boston Piers area, including transportation system management (TSM) actions such as underground exclusive bus lanes and a subsurface bus terminal.

3. **At-Grade Light Rail**: Articulated light rail vehicles operating on a surface transit reservation between the Boston Marine Industrial Park and Dewey Square initially, with a later at-grade extension above the depressed Central Artery to North Station.

4. **Fort Point Channel Underground Transitway**: People movers, light rail vehicles, or buses operating subsurface between the Boston Marine Industrial Park, South Station, and Boylston Station, with intermediate stops at the World Trade Center and Fan Pier/Pier 4.

5. **Red Line Loop**: Diversion of the existing Red Line heavy rail system between Broadway and South Stations, under the Seaport Access Road to a new station located under the East Service Road.

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[2] City of Boston and Boston Redevelopment Authority. *Fort Point Channel District Plan: Framework for Discussion.* June 1987.

[3] Massachusetts Bay Transportation Authority. *South Boston Piers/Fort Point Channel Transit Alternatives Draft Environmental Impact Report.* EOEA Number 6826. Prepared by URS Consultants, Inc. September 1989.

The DEIR was circulated in the fall of 1989 to Massachusetts government agencies, interested organizations, and citizens. In this document, the analysis methodologies and results were summarized, and further screening of alternatives was described. Based on such analyses and screening, the Fort Point Channel Underground Transitway using either trackless trolleys or dual mode buses was designated as the DEIR's chosen alternative. The Transitway tunnels would be designed and constructed to accommodate a conversion to light rail technology should this be required by future land use patterns and demands. The major advantages of the Transitway include the ability for staged implementation, an important feature given limited public funding and uncertainty about development patterns; attraction of more riders than any other alternative analyzed; ability to serve other markets, including the Midtown District, residential South Boston, Logan Airport via the Third Harbor Tunnel, continuation of service toward a circumferential corridor, and the Washington Street Corridor through possible integration with the Replacement Transit Project at Boylston Station; integration with the MBTA's existing system, including connections with the Red, Orange, and Green Lines and commuter and intercity bus and rail; and a joint construction opportunity with the depressed northbound Central Artery that would afford a 40 percent cost savings for this segment of the transit project and a reduction in backfilling costs for the Central Artery Project.

The Certificate of the Secretary of Environmental Affairs on the transit project (February 12, 1990) concurred with selection of the Fort Point Channel Underground Transitway as the preferred alternative. The Secretary agreed with the results of the analysis presented in the DEIR and directed the MBTA to carry only the Transitway to a higher level of analysis in the concluding stage of the state environmental review process as documented in the FEIR.

Prior to initiation of the FEIR, however, the MBTA requested the FTA to advance the South Boston Piers/Fort Point Channel Transit Project into the federal alternatives analysis/EIS process. Federal approval was issued on August 29, 1990. A Notice of Intent to undertake the EIS was published in the *Federal Register* on October 23, 1990, and a federal scoping session was held on November 8, 1990 at MBTA offices in South Station, Boston. In subsequent discussions with the MEPA Unit, it was agreed to also publish the DEIS as a supplemental DEIR in order to reconcile the state and federal environmental review processes for the project.

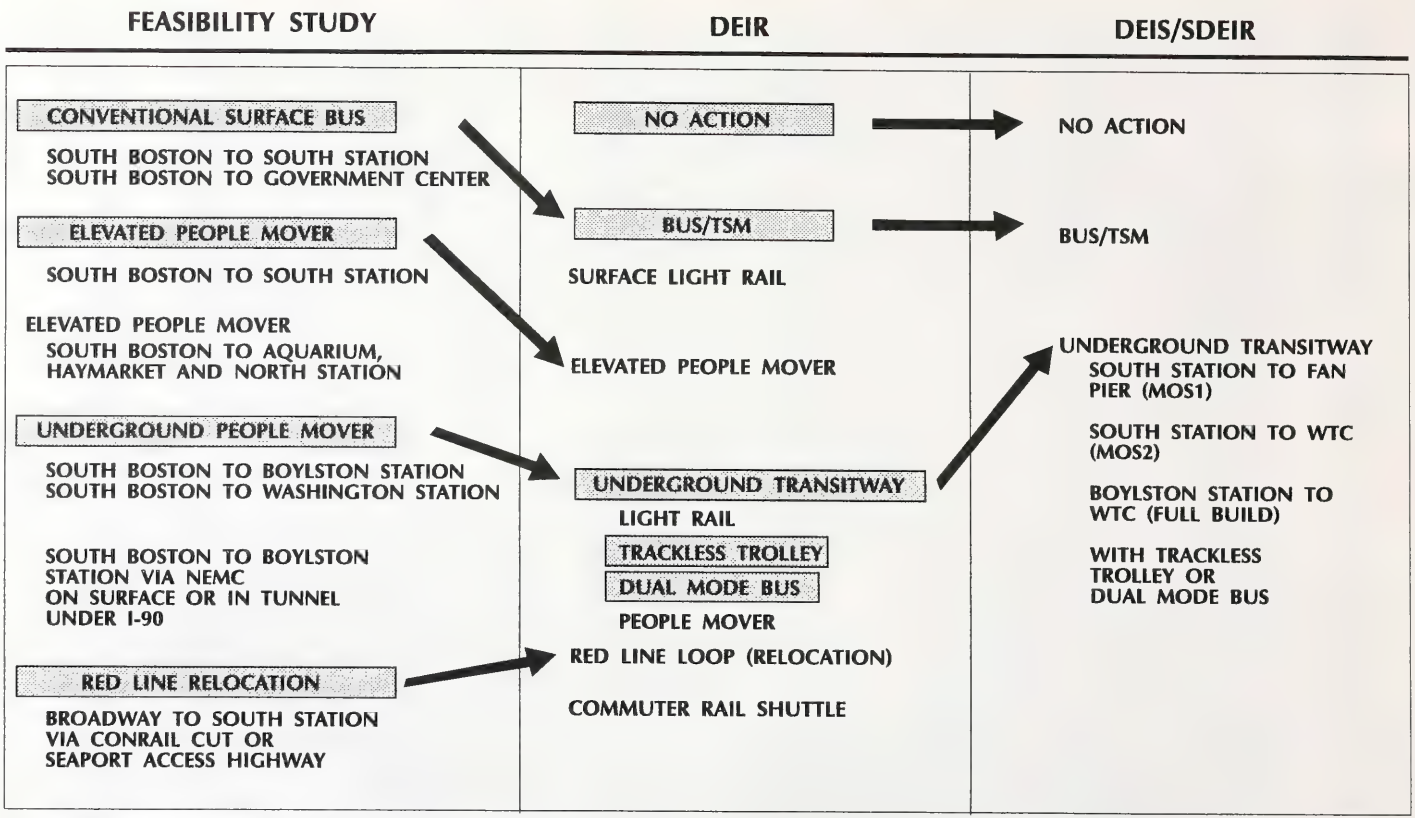
The DEIS/SDEIR examined the following alternatives:

1. ***No Action: Incremental increases in existing bus routes in the Piers area.***

2. ***Bus/TSM: Provision of a maximum feasible level of bus service on available streets and highways, and the implementation of TSM measures such as the use of articulated buses, utilization of a bus lane on New Congress Street, and surface stations to facilitate passenger handling.***

3. ***Fort Point Channel Underground Transitway: Operation of either trackless trolleys or dual mode buses in an underground transit tunnel connecting existing MBTA services and critical development centers in the Piers area. Three termini alternatives examined for the Transitway were the Full Build, extending from Boylston Station to the World Trade Center, and two Minimum Operable Segments (MOS), with MOS-1 extending from South Station to the Fan Pier, and MOS-2 extending from South Station to the World Trade Center.***

Figure P-1 depicts the progression of project alternatives, from the feasibility study to the DEIS/SDEIR.


FEASIBILITY STUDY
DEIR
DEIS/SDEIR
CONVENTIONAL SURFACE BUS
SOUTH BOSTON TO SOUTH STATION
SOUTH BOSTON TO GOVERNMENT CENTER
ELEVATED PEOPLE MOVER
SOUTH BOSTON TO SOUTH STATION
ELEVATED PEOPLE MOVER
SOUTH BOSTON TO AQUARIUM, HAYMARKET AND NORTH STATION
UNDERGROUND PEOPLE MOVER
SOUTH BOSTON TO BOYLSTON STATION
SOUTH BOSTON TO WASHINGTON STATION
SOUTH BOSTON TO BOYLSTON STATION VIA NEMC ON SURFACE OR IN TUNNEL UNDER I-90
RED LINE RELOCATION
BROADWAY TO SOUTH STATION VIA CONRAIL CUT OR SEAPORT ACCESS HIGHWAY
NO ACTION
BUS/TSM
SURFACE LIGHT RAIL
ELEVATED PEOPLE MOVER
UNDERGROUND TRANSITWAY
LIGHT RAIL
TRACKLESS TROLLEY
DUAL MODE BUS
PEOPLE MOVER
RED LINE LOOP (RELOCATION)
COMMUTER RAIL SHUTTLE
NO ACTION
BUS/TSM
UNDERGROUND TRANSITWAY
SOUTH STATION TO FAN PIER (MOS1)
SOUTH STATION TO WTC (MOS2)
BOYLSTON STATION TO WTC (FULL BUILD)
WITH TRACKLESS TROLLEY OR DUAL MODE BUS
DENOTES ALTERNATIVE CARRIED OVER INTO SUBSEQUENT PHASE

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. P-1
Progression of Alternatives Studied

The DEIS/SDEIR was circulated for review in November 1992. A public comment period lasting 45 days was provided, and a public hearing was conducted on December 9, 1992. On January 13, 1993, the Massachusetts Secretary of Environmental Affairs issued a certificate finding the DEIS/SDEIR adequate and in compliance with the Massachusetts Environmental Policy Act.

Comments from twenty-seven reviewers of the DEIS/SDEIR were submitted in writing to the FTA and/or the MEPA Unit. Commenters included federal, state, regional, and local agencies, business and civic organizations, and private citizens. All comments were assessed and incorporated into the decisionmaking process for determining the locally preferred alternative for the project. Based on the comments received and the results of the technical analyses presented in the DEIS/SDEIR, the Fort Point Channel Underground Transitway Full Build Alternative was designated as the Locally Preferred Alternative. The Full Build Alternative was explicitly endorsed by fourteen of the twenty-seven commenters on the DEIS/SDEIR. In June 1993, the FTA approved the initiation of preliminary engineering and continuing environmental analysis for the locally preferred alternative.

Contents of the FEIS/FEIR

This FEIS/FEIR represents a final revision of the DEIS/SDEIR, responding to all comments received on the draft document and presenting additional details on the impacts of and mitigation for the locally preferred alternative. As such, the FEIS/FEIR provides a comprehensive assessment of the consequences of each project alternative on the transportation system, economic development, and social and natural environment, in addition to estimation of capital and operating costs, cost-effectiveness, and financing for each alternative.

Substantive changes from the DEIS/SDEIR are indicated in this FEIS/FEIR in bold italics. No substantive deletions have been made.

The FEIS/FEIR consists of one main volume with two separate appendices. The Design Drawings Appendix provides plans and profiles for each Transitway alternative. The Response to Comments Appendix addresses all written comments received on the DEIS/SDEIR as well as on the earlier DEIR. Wherever possible, responses are referenced to relevant sections of the FEIS/FEIR.

The contents of the six chapters that comprise the FEIS/FEIR are described as follows:

Chapter 1: Purpose and Need — This chapter serves as an introduction to the FEIS/FEIR. It provides a general description of the project area and current transportation services, presents a statement of the project goals and objectives, and identifies anticipated transportation problems.

Chapter 2: Alternatives Considered — This chapter summarizes the scoping and alternatives screening process and describes in detail the alternatives fully analyzed. ***It also describes the rationale for selecting the Fort Point Channel Underground Transitway Full Build Alternative as the locally preferred alternative.***

Chapter 3: Affected Environment — This chapter provides an overview of the current social, economic, and environmental conditions of the project area. It also describes the methodologies used to identify significant resources and assess the potential impact of project alternatives on such resources.

Chapter 4: Transportation Impacts — This chapter presents an analysis and discussion of the transportation impacts expected to result from the transit alternatives examined for this project.

Chapter 5: Environmental Consequences — This chapter describes the potential environmental impacts of the project alternatives in terms of the following categories: neighborhoods, land use, and economic activity; energy; aesthetics; air quality; noise and vibration; ecosystems; water resources; sediment disposal; archaeological resources; historic resources; and parklands.

Chapter 6: Evaluation of Alternative — This chapter evaluates the financial feasibility of the project alternatives. It also compares the benefits and costs of each alternative and the ability of each alternative to meet project goals and objectives. A cost-effectiveness evaluation is presented. Trade-offs among alternatives are also presented.

Additional Information — ***Four appendices included in the FEIS/FEIR consist of (1) a draft Process Memorandum of Agreement between the FTA, the Massachusetts Historical Commission in its capacity as the State Historic Preservation Officer, and the Advisory Council on Historic Preservation, with concurrence from the MBTA and the Boston Landmarks Commission, which outlines a process for mitigating potential impacts to historic and archaeological resources; (2) a list of reference documents used to prepare the FEIS/FEIR; (3) a list of preparers; and (4) a distribution list. Locations at which the public can review the FEIS/FEIR are identified in the distribution list.***

Technical data presented in this FEIS/FEIR were prepared in accordance with the FTA's *Procedures and Technical Methods for Transit Project Planning* (September 1986, updated June and July 1989 and September 1990).

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EXECUTIVE SUMMARY

ES.1 PURPOSE AND NEED

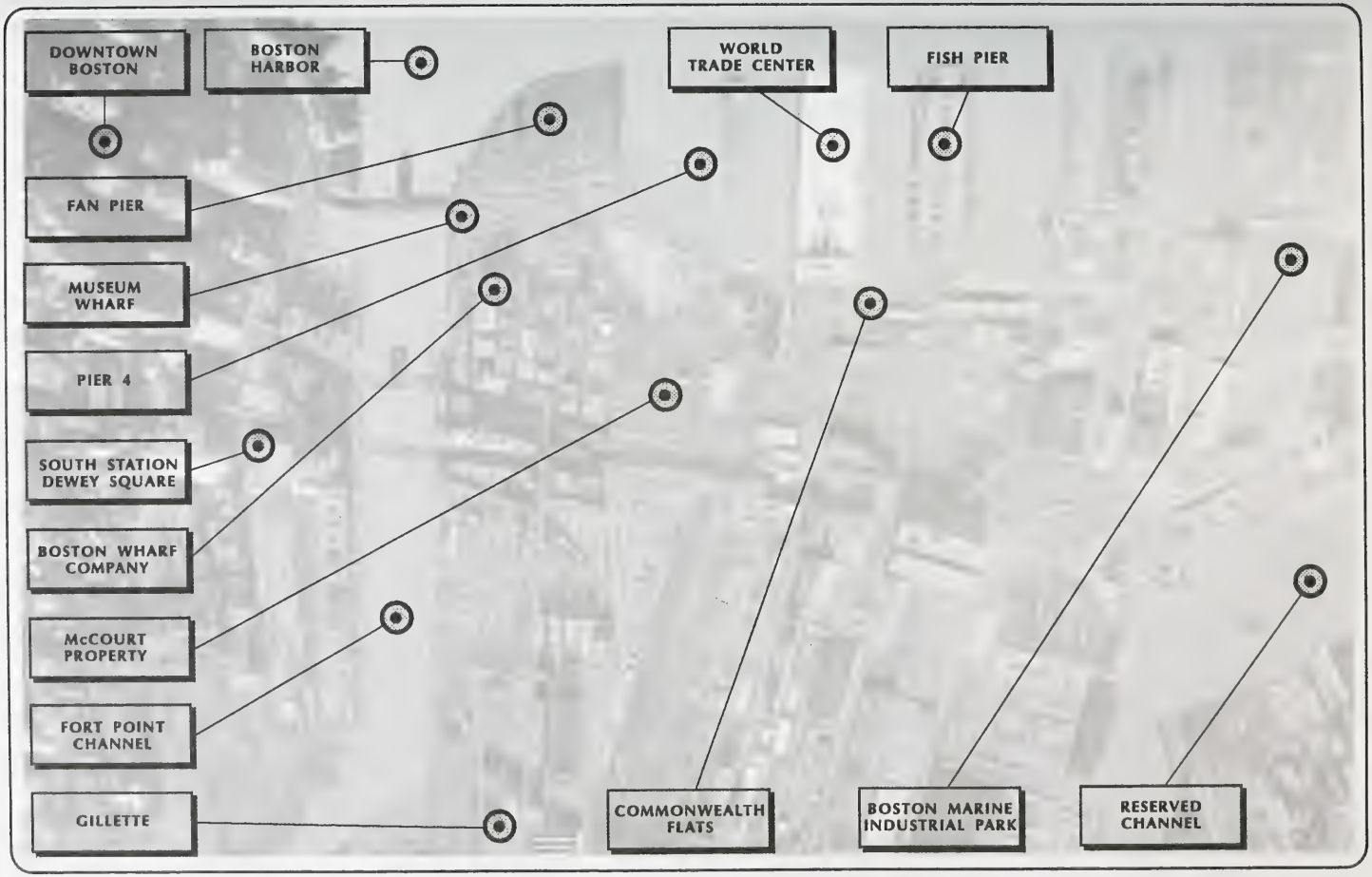
The South Boston Piers/Fort Point Channel area shown in Figure ES-1 is composed of approximately 300 acres of underutilized land located directly east of Boston's central business district (CBD) and one mile south of Logan International Airport across the Boston Harbor. Existing land uses in the Piers area echo its once vibrant waterfront history. Industrial activities dominate the area and generally focus around the seafood industry, including fishing, fish processing, wholesale, retail, and restaurant sales as well as related boat and equipment sales and repairs, and the Boston Marine Industrial Park (BMIP). BMIP is a former U.S. military reservation at the eastern end of the Piers area that is now used by the City of Boston's Economic Development and Industrial Corporation for the promotion of light industrial and maritime uses.

Other major uses in the Piers area reflect the gradual conversion of former industrial activities to other uses. Major conversions along the western edge of the area include the nineteenth century warehouses of the Boston Wharf Company, which are being rehabilitated for office and residential use, as well as Museum Wharf. Museum Wharf is home to three popular museums — the Children's Museum, the Computer Museum, and the Boston Tea Party Ship Museum. The major conversion in the center of the Piers area involved replacement of the maritime activities at Commonwealth Pier with the World Trade Center, a conference and exhibition facility completed in 1986.

Despite its location near the crossroads of the regional transportation network, the Piers area currently suffers from limited accessibility. Three local bridges serve most automobile and pedestrian traffic, while three local bus routes provide the only transit service. Planned roadway improvements, including the Central Artery (I-93)/Third Harbor Tunnel (I-90) Project, construction of a New Northern Avenue bridge, and creation of a new local street network, would greatly improve access to the relatively isolated Piers area. Given these improvements combined with unique locational advantages, such as adjacency to downtown Boston and Logan International Airport, deep port capabilities, and full interchange to the state highway system and other transportation infrastructure, the Piers area has been targeted for intense future development. According to growth projections developed for the CA/T Project, the Piers area, containing 9 million square feet of development today, could accommodate more than 21 million square feet by the year 2010. A shift from land uses, such as industrial activities, that generate relatively low levels of trip demand per square foot of development, to other uses, such as offices and retail establishments, that generate significantly higher demand, would have an amplifying effect on the demand for transportation. Major development projects slated for the Piers area in the next decade include construction of the recently sited Federal Courthouse at Fan Pier, the World Trade Center expansion, Summer Street office conversion, mixed-use development of the McCourt Company properties, and continued growth at BMIP.

Increased development brings increased traffic. Anticipated development in the Piers area is projected to generate an increase in trip demand from roughly 7,000 peak hour, peak direction trips each day to possibly as many as 18,000 peak hour, peak direction trips by 2010. Daily one-way trips could increase from 40,000 to as many as 90,000 trips during the same period.

The interfaces between Piers area roadways and the CBD currently produce some of the worst traffic congestion in the city. At present, the intersections of Atlantic Avenue with Northern Avenue and Congress Street both operate at traffic level of service (LOS) F in the p.m. peak hour, while the Atlantic Avenue/Summer Street intersection operates at LOS E. Approach delays at these three intersections exceed 60 seconds and cause traffic to back up on the arterials into the Piers area. When the additional trip demand that would be generated by proposed Piers area development is added to the local street network, severe traffic congestion (LOS F) occurs at a number of key intersections including Summer



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. ES-1
Aerial View of the South Boston Piers/Fort Point Channel Area

Street/D Street, Massport Haul Road/D Street, and Congress Street/East Service Road where the delay totals three minutes. Although planned roadway improvements described above would greatly improve access to the relatively isolated area, regional policy is to accommodate this travel on mass transit. Furthermore, unless transit service to the Piers area is provided, the demand for roadway access could far outstrip capacity. As a consequence, the total amount of new Piers area development could be capped by the occurrence of gridlock conditions and unacceptable environmental conditions, limiting the potential expansion of the city's economic base. A lower cap on development in the Piers area could also jeopardize the region's ability to strategically position itself for competition in the new global economy, including international trade, biotechnology, and airport/seaport facility development.

This South Boston Piers/Fort Point Channel Transit Project was undertaken with the expectation that the provision of high capacity, high quality transit service would divert a large percentage of trips from the street and highway network. It was further expected that a transit link between major regional rapid transit and commuter rail lines would help ensure that development goals can be achieved in an environmentally sound manner.

It must be recognized, however, that the Piers area has been affected by the effects of the recent national and regional economic slowdown. The corresponding slowdown in Boston's employment growth, in particular, has added an element of uncertainty to the magnitude of development forecasts for this area. For these reasons, two development growth scenarios are presented throughout this document.

One set of growth projections used for the South Boston Piers area was developed for the Massachusetts Highway Department's (MHD, formerly the Massachusetts Department of Public Works) CA/T Project. These projections represent a comprehensive compilation of data on existing (1986 base) and future land use for downtown Boston and its immediate surroundings. They were extensively reviewed by the Boston Redevelopment Authority during planning of the CA/T Project and are generally consistent with city policies. In order to ensure consistency in traffic and transit ridership forecasting, the CA/T Project growth projections are presented in this document as one basis for assessing transportation and environmental impacts of the transit project. These twenty-year growth projections are being widely used by state and local planners to estimate future development in Boston's CBD and surrounding areas, including the South Boston Piers area.

As with any twenty-year forecast, however, some uncertainty about the magnitude and timing of future development is inevitable. To address this uncertainty, a lower growth development scenario and associated ridership projections for 2010 are presented throughout this document. The lower growth scenario is based directly on the CA/T Project development forecasts for 2000 including the underlying zonal and land use parameters. For purposes of differentiation, the 2010 CA/T Project forecasts are referred to as a "high" growth scenario for 2010, while the 2000 forecast is referred to as a "lower" growth scenario for 2010. The lower growth scenario is not necessarily to be viewed as a lowest bound on what may occur. Development forecasts for the two growth scenarios are presented in Table ES-1.

ES.1.1 Project Goals

The South Boston Piers/Fort Point Channel Transit Project is part of a comprehensive effort to achieve a series of broad transportation and regional development goals, as well as specific objectives for improving the quality of transportation services throughout the project service area which includes the Piers area in addition to a portion of downtown Boston. The establishment of these goals and objectives and the development of the transportation plan and program to accomplish them has been supported by an ongoing policy-making and planning process. Specific project goals are as follows:

TABLE ES-1: SOUTH BOSTON PIERS/FORT POINT CHANNEL AREA CURRENT AND PROJECTED LAND USE (thousands of square feet)

Land Use Category	Base	2010 Lower Growth	2010 High Growth
Office	2,342.8	6,015.0	10,322.5
Retail	290.3	435.8	833.7
Cultural/Recreational	554.9	592.9	663.4
Industrial	5,862.7	6,039.4	6,172.6
Hotel	0.0	229.0	1,445.0
Residential	102.9	770.7	2,064.3
Transportation	182.6	227.6	232.6
Total	9,336.2	14,310.4	21,734.1

Source: Massachusetts Department of Public Works. *Land Use Projections for the Boston Metropolitan Core, 1986-2010.* July 1989.[1]

- Improve transit service to the Piers area
- Enable future economic expansion of the Piers area
- Mitigate potential traffic problems in the Piers area generated by projected development
- Minimize degradation of the natural environment
- Preserve cohesion of existing neighborhoods and communities
- Provide adaptable and reliable transit service
- Provide efficient and productive transit service

[1] ***Zonal designations and development projections presented throughout this document reflect projections prepared for the CA/T Project in July 1989. Piers area development projections shown are consistent with the land use projections for the expanded Boston metropolitan core prepared for the CA/T Project in December 1992.***

ES.1.2 Purpose of the Final Environmental Impact Statement/Final Environmental Impact Report

The purpose of the Final Environmental Impact Statement/Final Environmental Impact Report (FEIS/FEIR) for the Massachusetts Bay Transportation Authority's (MBTA) South Boston Piers/Fort Point Channel Transit Project is to identify a locally preferred alternative from all the alternatives considered, and to respond to comments submitted on the state Draft Environmental Impact Report (DEIR) and combined federal and state Draft Environmental Impact Statement/Supplemental Draft Environmental Impact Report (DEIS/SDEIR). The FEIS/FEIR also specifies mitigation for environmental and other impacts associated with the locally preferred alternative.

Planning for the South Boston Piers/Fort Point Channel Transit Project has been ongoing since 1987. Work conducted during the state DEIR process provided the groundwork for preparation of the federal DEIS and SDEIR. A subset of alternatives identified, screened, analyzed, and evaluated in the DEIR were refined and further analyzed in the DEIS/SDEIR. As the document in which alternative transportation solutions were defined and the results of technical analyses compiled, the DEIS/SDEIR served as the vehicle for public review and input from federal, state, and local agencies and other interested parties. ***During a 45 day comment period, a public hearing was held and twenty-seven written comments were received. Based on this public input and the results of the analyses presented in the DEIS/SDEIR, the MBTA designated the Full Build Transitway utilizing trackless trolley technology as the locally preferred alternative.***

This FEIS/FEIR is being circulated to all federal, state, and municipal agencies and officials whose jurisdictional responsibilities may be impacted by the South Boston Piers/ Fort Point Channel Transit Project. In addition, it is being made available to the public through libraries and other public sources. The MBTA will sponsor a public meeting during the FEIS/FEIR comment period.

ES.1.3 Major Changes From the DEIS/SDEIR

The FEIS/FEIR contains the text presented in the DEIS/SDEIR as it has been revised to address comments received on the draft document. All substantive changes are noted in bold italics. No substantive deletions have been made.

In addition, changes to the Transitway alignment are analyzed. These changes are as follows:

- ***The Transitway tunnel now turns eastward from Atlantic Avenue at Congress Street rather than south of New Northern Avenue. This alignment change was necessitated by Transitway operational concerns raised by refinements made to the CA/T Project's profile for the northbound Central Artery as well as the vent building structure at the Boston Edison parcel, which restricted the possible alignment of the Transitway. The revised Transitway alignment requires the underpinning of the Russia Wharf Buildings and eliminates permanent impacts to the Fort Point Channel.***

- ***The Transitway tunnel and Courthouse Station (referred to as "Fan Pier Station" in the DEIS/SDEIR) are now located fully beneath the right-of-way limits of New Northern Avenue. This realignment avoids impacts to developable parcels.***

- ***The turnaround loop at Boylston Station has been extended west beneath Boylston Street; in the DEIS/SDEIR, it was assumed that the loop would be below the station. This extension is necessitated for operational reasons, but would be constructed using hand mining techniques to avoid impacts to the Central Burying Ground and to other historic resources in the area of Boylston Station and the Boston Common.***

The State of Massachusetts environmental process will culminate, after review and acceptance of this FEIS/FEIR, in the issuance of a written statement by the Secretary of the Executive Office of Environmental Affairs that the FEIS/FEIR adequately and properly complies with the provisions of

the Massachusetts Environmental Policy Act and its associated regulations. The federal environmental review process will culminate in a Record of Decision issued by the Federal Transit Administration.

ES.2 ALTERNATIVES CONSIDERED

ES.2.1 Selection and Screening of Alternatives

The selection and screening of alternatives for the South Boston Piers/Fort Point Channel Transit Project has been ongoing since the summer of 1987 when the MBTA initiated a feasibility study[2] to provide a preliminary evaluation of new public transit alternatives to meet the travel demands of future development in the Piers area. Ideas on potential additional transit services were solicited from a wide range of consultants, interested parties, and local agencies, including the Massachusetts Port Authority, Boston Transportation Department, Massachusetts Highway Department, and the Boston Redevelopment Authority. In addition, the study developed modifications of transit proposals that had been advanced by private developers. The participants in the study reached a consensus that any new transit service must emphasize connections to current MBTA rail lines, providing service to as many regional corridors as possible with minimum transfers.

Based on agency suggestions, public involvement, and analysis by the study team, alternatives were categorized by distinct linkages from the Piers area to existing or projected transit resources. The possibilities included various transit technology, destination, and alignment options. From the approximately 250 logical combinations that could be formed from these options, six alternatives were identified for further analysis. These alternatives included conventional surface bus service, two elevated and one underground people mover alignments, elevated guided bus, and a relocated Red Line.

Concurrent with preparation of the feasibility study, city officials and private citizens began the process of formalizing a plan to guide future development of the Piers area. The Boston Redevelopment Authority, with significant input from the Fort Point Citizens Advisory Committee and the Mayor's Office of Neighborhood Services, drafted the *Fort Point Channel District Plan*[3] in June 1987. The plan determined that the development plans and economic revitalization of the Piers area hinged on substantially improved access, including a major investment in new public transportation. The feasibility study echoed these conclusions and recommended that a formal environmental impact analysis be initiated to enable a comprehensive evaluation of viable alternatives.

A *Draft Environmental Impact Report* (DEIR)[4] was initiated in the fall of 1989 pursuant to the requirements of the Massachusetts Environmental Policy Act (MEPA). The DEIR was intended to provide a conceptual analysis of various long-term approaches for the extension of transit service to the South Boston Piers area. As a result of the state scoping process held for the project, the MBTA was directed by the Secretary of the Massachusetts Executive Office of Environmental Affairs to prepare a DEIR analyzing seven alternatives, two of which — the Elevated People Mover and the South Station/ South Boston Rail Shuttle — were eliminated in the early phases of the DEIR due to urban design and operational problems. The following five alternatives were analyzed in terms of effectiveness (extent to which each alternative achieves the goals of the project), environmental impacts, financial feasibility, and cost-effectiveness:

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[2] Massachusetts Bay Transportation Authority. *South Boston Piers/Fort Point Channel Transit Feasibility Study*. Prepared by URS Corporation. July 1987.

[3] City of Boston and Boston Redevelopment Authority. *Fort Point Channel District Plan: Framework for Discussion*. June 1987.

[4] Massachusetts Bay Transportation Authority. *South Boston Piers/Fort Point Channel Transit Alternatives Draft Environmental Impact Report*. EOEA Number 6826. Prepared by URS Consultants, Inc. September 1989.

1. **No Action**: Incremental increases in current bus routes.

2. **Bus/TSM**: High frequency shuttle bus service from South Station, Park Square, and North Station to the South Boston Piers area, including transportation system management (TSM) actions such as underground exclusive bus lanes and a subsurface bus terminal.

3. **At-Grade Light Rail**: Light rail vehicles operating on a surface transit reservation between the Boston Marine Industrial Park and Dewey Square initially, with a later at-grade extension above the depressed Central Artery to North Station.

4. **Fort Point Channel Underground Transitway**:[5] People movers, light rail vehicles, or buses operating subsurface between the Boston Marine Industrial Park, South Station, and Boylston Station, with intermediate stops at the World Trade Center and Fan Pier.

5. **Red Line Loop**: Diversion of the existing Red Line heavy rail system between Broadway and South Stations, under the Seaport Access Road to a new station located under the East Service Road.

The DEIR was circulated in the fall of 1989 to Massachusetts government agencies, interested organizations, and citizens. In this document, the analysis methodologies and results were summarized, and further screening of alternatives was described. Based on such analyses and screening, the Fort Point Channel Underground Transitway using either trackless trolleys or dual mode buses was designated as the locally preferred alternative. The Transitway tunnels would be designed and constructed to accommodate a conversion to light rail technology should this be required by future land use patterns and demand. The major advantages of the Transitway include its ability for staged implementation, an important feature given limited public funding and uncertainty about development patterns; attraction of more riders than any other alternative analyzed; ability to serve other markets, including the Midtown District, residential South Boston, Logan Airport via the Third Harbor Tunnel, the Washington Street Corridor through possible integration with the Replacement Transit Improvement Project at Boylston Station, and continuation of service toward a circumferential corridor; integration with the MBTA's existing system, including connections with the Red, Orange, and Green Lines and commuter and intercity bus and rail; and a joint construction opportunity with the depressed northbound Central Artery that would afford a 40 percent cost savings for this segment of the transit project and a reduction in backfilling costs for the Central Artery Project.

The Certificate of the Secretary of Environmental Affairs on the transit project (February 12, 1990) concurred with selection of the Fort Point Channel Underground Transitway as the locally preferred alternative. The Secretary agreed with the results of the analysis presented in the DEIR and directed the MBTA to carry only the Transitway to a higher level of analysis in the concluding stage of the state environmental review process as documented in the FEIR.

Prior to initiation of the FEIR, however, the MBTA requested the FTA to advance the South Boston Piers/Fort Point Channel Transit Project into the federal alternatives analysis/Draft Environmental Impact Statement (DEIS) process. Based on the analysis and conclusions of the DEIR, the FTA allowed the MBTA to eliminate several of the previously studied alternatives from consideration in the federal DEIS process. A Notice of Intent to undertake the DEIS was published in the *Federal Register* on October 23, 1990.

Given that the Certificate of the Massachusetts Secretary of Environmental Affairs was issued for the project's DEIR almost a year earlier, the DEIS was also published as a Supplemental DEIR. The intention

[5] This alternative was referred to in the feasibility study as the *Underground People Mover*. The name was changed in the DEIR to reflect the variety of mass transit technologies that could be operated in the Transitway tunnel.

was to reconcile the state and federal environmental review processes prior to preparation of a combined federal and state FEIS/FEIR.

ES.2.2 Alternatives Analyzed in the DEIS/SDEIR

The alternatives that were examined in detail in the DEIS/SDEIR are as follows:

1. **No Action Alternative**: Under the No Action Alternative, the MBTA would increase the frequency of existing bus routes in the area, expand service areas slightly, and make use of new road systems which are presently in an advanced stage of planning and design. This alternative does not include new facilities or routes but does include the acquisition of a small number of additional buses to operate on existing routes.

2. **Bus/TSM Alternative**: A Surface Bus/Transportation System Management (TSM) Alternative was developed to increase transit mode share by providing a maximum feasible level of bus service on available streets and highways. Buses in this alternative would circulate through the Piers area in a dispersed loop pattern. In order to more efficiently route these buses, several different TSM measures would be applied. These TSM measures would include the use of articulated buses on some services, utilization of a bus lane on New Congress Street in the high growth scenario, and surface stations to facilitate passenger handling.

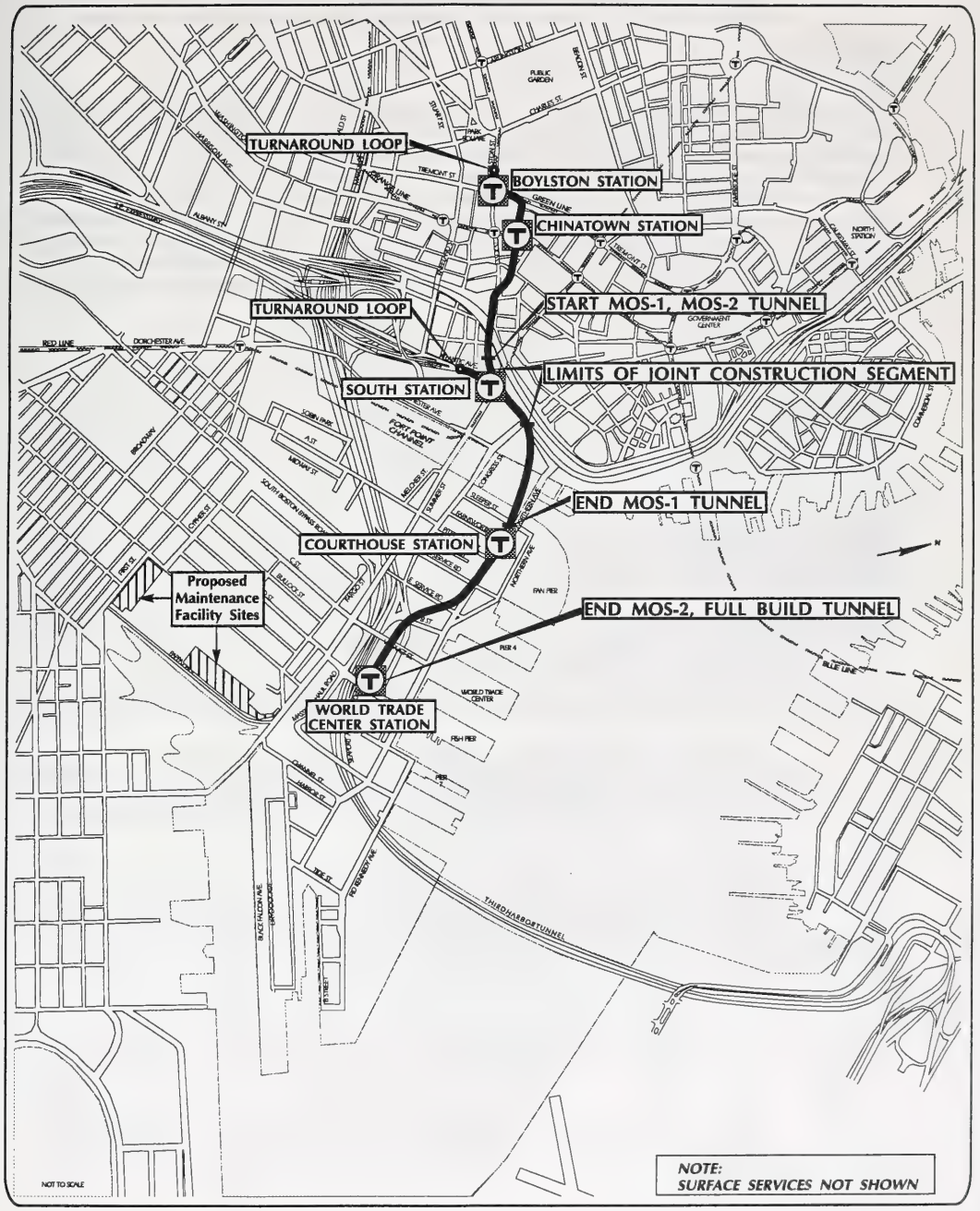
3. **Fort Point Channel Underground Transitway Alternatives**: The Fort Point Channel Underground Transitway Alternatives represent a fixed guideway solution to linking areas of new development in the South Boston Piers area with regional mass transit services in downtown Boston. An underground transit tunnel provides a connection between existing MBTA services and critical development centers in the Piers area, while the use of bus technology offers operational flexibility needed to meet evolving demand. Transitway service would be operated with either trackless trolleys or dual mode buses. Trackless trolleys would be electrically powered via catenary both in the tunnel and on surface streets. Dual mode buses would also use electric power in the transit tunnel, but would switch to diesel power on surface streets.

   As shown in Figure ES-2, three termini alternatives were considered for the Underground Transitway: a Full Build Alternative and two Minimum Operable Segment (MOS) Alternatives. The figure shows only the tunnel segment associated with each termini alternative; surface routes supplement services provided in the Transitway tunnel. Under the Full Build Alternative, the Transitway tunnel would extend from Boylston Station in the west to the World Trade Center in the Piers area. The two MOS Alternatives represent shorter versions of the project that could be implemented on an incremental basis. In both MOS Alternatives, the Underground Transitway tunnel would begin in the west at South Station and extend to either Fan Pier in the western Piers area (MOS-1) or to World Trade Center (MOS-2). Tunnel construction in either MOS option would be designed to accommodate later extension of the Transitway tunnel to the full build limits. In all termini alternatives, service would be provided at surface between the Transitway tunnel portal and BMIP and Summer Street. The portal would be located at Fan Pier in the MOS-1 Alternative and at the World Trade Center in the MOS-2 and Full Build Alternatives.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Figure ES-2
Underground
Transitway
Alternatives



accommodate later extension of the Transitway tunnel to the full build limits. In all termini alternatives, service would be provided at surface between the Transitway tunnel portal and BMIP and Summer Street. The portal would be located at Fan Pier in the MOS-1 Alternative and at the World Trade Center in the MOS-2 and Full Build Alternatives.

ES.2.2.1 The Locally Preferred Alternative

The locally preferred alternative for the South Boston Piers/Fort Point Channel Transit Project, selected as the result of the DEIS/SDEIR process, is the Fort Point Channel Underground Transitway Full Build Alternative. The Full Build Alternative represents the optimization of both a fixed guideway and bus solution to serving future growth in trip demand generated by new development in the South Boston Piers area. A 1.5-mile underground transit tunnel from Boylston Station to the World Trade Center combined with surface bus operations on streets where congestion is projected to be minimal will link this new development with regional mass transit services in downtown Boston. Five underground Transitway stations and numerous surface bus stations will provide connections to the Red, Orange, and Green Lines as well as commuter and intercity rail and bus services.

Trackless trolleys will be operated in the Transitway tunnel and on two surface routes in the easternmost portion of the Piers area and on a third route to residential South Boston. Conventional buses will supplement this service on surface streets. A storage and maintenance facility will be constructed to accommodate a fleet of up to 166 vehicles, 53 of which will be articulated trackless trolleys. Two potential sites on a parcel bordered by Summer Street, Pappas Way, West First Street, and E Street are being considered for this facility. Site A is located in the northeastern corner of the parcel, while Site B is located in the southern portion (refer to Figure ES-2).

Construction of the Full Build Alternative will be staged. The initial phase is MOS-2, the tunnel segment from South Station to the World Trade Center with three underground Transitway stations at South Station, the new Federal Courthouse/Fan Pier, and the World Trade Center. This phase is expected to be operational in the year 2000. The second phase of the project — the tunnel from South Station to Boylston Station — is scheduled to be open for revenue service by 2008. Between 1998 and opening of the first phase of the project in 2000, interim bus service will be operated to serve existing and near-term development in the Piers area.

The Full Build Transitway was shown to outperform all alternatives in terms of each project goal:

- ***Under the Full Build Alternative, transit ridership and mode share to the Piers area would be the highest of all alternatives analyzed. The Full Build Alternative would attract a 62 percent transit mode share in the a.m. peak hour, and the daily mode share would be only 2 percentage points lower than that projected for downtown Boston.***

- ***Since the travel time from the regional transit system to the Piers area in the Full Build Alterative would be equal or better than that under any other alternative, and given the free underground transfers to the Transitway offered at three of the four MBTA rapid transit lines, the Full Build Alternative offers maximal time and fare benefits to users.***

- ***Less than 3 percent of all trips to the Piers area are comprised of walking across the Fort Point Channel into the Piers area, fewer than in any other alternative. This is an important user convenience benefit.***

- ***As evidenced by the increase in the number of non-Piers area riders using the Transitway tunnel services in comparison to services in the other alternatives, the Full Build Alternative is unique in its ability to benefit other transit riders in the region.***

- ***The Full Build Alternative is the only alternative analyzed that can fully support the 2010 development goals for the South Boston Piers area of 21.7 million square feet.***

- ***The significant improvements in on-street conditions afforded by the Full Build Alternative include a reduction of 11,000 automobile trips each day; the highest vehicle operating speeds of any alternative analyzed; operation of all signalized intersections at level of service D or better; and a nearly 55 percent reduction in the maximum average intersection delay over the No Action Alternative. As compared to the Bus/TSM Alternative, the Full Build Alternative also achieves the greatest reduction of daily vehicle miles traveled (VMT) at over 300,000.***

- ***The Full Build Alternative contributes most to the cohesiveness of existing neighborhoods, since construction of an underground Transitway tunnel from Boylston Station to the World Trade Center will substantially reduce vehicular traffic on surface streets.***

- ***The Full Build Alternative would produce the most passenger miles in exclusive, weather-protected right-of-way of any alternative analyzed. This is an important measure of service reliability.***

- ***The Full Build Alternative is the most productive of any of the alternatives analyzed, serving over 50 percent more passengers per vehicle hour or over 25 percent more passengers per vehicle mile than the next best performing alternative.***

- ***The Full Build Alternative is the most cost-effective alternative analyzed according to both the new trip index and the user benefit index. Thus, despite being the most expensive alternative to implement, these indices show that the benefits afforded by the Full Build Alternative outweigh its costs in comparison to the other alternatives analyzed.***

ES.2.3 Capital and Operating and Maintenance Costs

Table ES-2 summarizes the capital and operating and maintenance (O&M) costs of each alternative in the lower growth and high growth scenarios.

TABLE ES-2: CAPITAL AND OPERATING AND MAINTENANCE COSTS BY ALTERNATIVE (millions of 1993 dollars)

	Lower Growth Scenario		*High Growth Scenario*	
Alternative	*Capital Costs*	*Annual O&M Costs*	*Capital Costs*	*Annual O&M Costs*
No Action	*$7.6*	*$4.3*	*$7.6*	*$4.3*
Bus/TSM	*$30.8*	*$10.4*	*$59.8*	*$20.2*
Transitway MOS-1	*$243.1*	*$14.2*	*$284.0*	*$25.4*
Transitway MOS-2	*$345.5*	*$14.7*	*$386.4*	*$25.5*
Transitway Full Build	*$553.2*	*$14.2*	*$597.4*	*$26.0*

ES.3 TRANSPORTATION IMPACTS

One of the primary goals of the South Boston Piers Transit Project is to improve transit service in the project area. A summary of transportation impacts is presented in Table ES-3 and discussed in the following sections.

ES.3.1 Level of Service Impacts

There are several components to transit level of service, or service quality. For the purposes of this project, the most important of these are travel time, cost, and comfort (as represented by the level of crowding on transit services).

ES.3.1.1 Travel Time

Since the project alternatives were designed to provide substantially improved transit service to the Piers area from the entire region, all of the action alternatives would enhance the current level of service from each regional corridor. Nevertheless, there are distinct advantages to particular alternatives for riders from certain corridors, both in terms of total travel time and the more onerous out-of-vehicle time.

To contrast the travel time benefits of the alternatives, travel times from several major radial transit lines to two representative destination zones in the Piers area — Fan Pier and the World Trade Center — were compared among alternatives. For riders on services radiating to the North (the Orange Line North and the Blue Line), travel times to the World Trade Center would improve in all action alternatives when compared to the No Action Alternative. For trips to Fan Pier, Orange Line North riders are projected to walk from State Street Station in the No Action Alternative and use the North Station shuttle bus in the action alternatives. Blue Line riders are projected to walk to Fan Pier from Aquarium Station in all alternatives; thus there are no travel time differences among alternatives from the Blue Line.

More significant travel time differences are projected to occur for riders on transit lines from the West (Green Line West and Orange Line South). The Bus/TSM and MOS Alternatives would provide identical shuttle bus services to the Piers area from these lines. The weighted travel times[6] to both Fan Pier and the World Trade Center using these shuttle services would be longer than the weighted travel times under the No Action Alternative, particularly from the Orange Line South. The Full Build Alternative would provide the shortest weighted travel time for riders from the west.

For trips from the Red Line and South Station commuter rail to Fan Pier, No Action and Bus/TSM Alternative travel times would be identical since riders are projected to walk from South Station. The Transitway Alternatives would provide better weighted travel times. There would be no difference between the MOS and Full Build Alternatives since all riders would board the Transitway at South Station.

In general, for riders from the West (Green Line West) and Southwest (Orange Line South), the Full Build Alternative would be the only action alternative with weighted travel times better than the No Action Alternative. For riders from the Northwest (Red Line North) and South (Red Line South and South Station commuter rail) corridors, the MOS and Full Build Alternatives would provide equal weighted travel times that are better than the Bus/TSM Alternative but, in some cases, worse than the No Action Alternative. These four corridors would constitute about 75 percent of transit riders to the Piers area. From the remaining corridors (Orange Line North and Blue Line), all of the action alternatives would offer similar travel times that would be equal to or better than No Action Alternative travel times.

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[6] A weighting factor of 2.5 was applied to out-of-vehicle-time to account for the perceived differences between in-vehicle and out-of-vehicle times. In other words, each minute of out-of-vehicle time is treated as equivalent to 2.5 minutes of in-vehicle time.

TABLE ES-3: SUMMARY OF SELECTED YEAR 2010 TRANSPORTATION IMPACTS BY ALTERNATIVE

Alternative	A.M. Peak Hour Transit Trips	A.M. Peak Hour Transit Mode Share	Daily Transit Trips	Daily Transit Mode Share	Annual Transit Trips (millions)	Passengers Per Vehicle-Hour	Passengers Per Vehicle-Mile	Decrease in VMT versus No Action
Lower Growth Scenario								
No Action	3,100	25%	16,800	25%	5.14	59	10.1	---
Bus/TSM	5,300	43%	19,300	28%	5.66	***69***	10.8	***111,689***
MOS	6,200	51%	22,000	33%	6.48	***84***	***12.8***	***144,786***
Full Build	6,600	54%	24,400	36%	7.18	***145***	***20.3***	***169,786***
High Growth Scenario								
No Action	4,300	23%	21,700	24%	6.83	89	15.3	---
Bus/TSM	9,300	51%	29,900	33%	8.80	***100***	15.7	***227,308***
MOS	10,600	59%	34,100	38%	10.02	***103***	***15.3***	***280,036***
Full Build	11,200	62%	37,100	41%	10.88	***158***	***21.0***	***311,428***

Note: Ridership and mode share measures represent inbound trips to the Piers area. Productivity measures reflect a.m. peak hour trips on new and modified services.

To put the above travel time differences in context, unweighted travel times were calculated from seventeen sample origin zones located throughout the region. The percent difference in total travel time between the Full Build and No Action Alternatives was calculated for each zone for trips to the World Trade Center. Each location was classified according to the percent travel time savings. The smallest savings (under 5 percent) are projected from both near-in and distant areas that have service to South Station. Only two locations fit into the middle category (6 to 10 percent savings); these are both on the outer ends of the Orange Line where total travel times are longer than from more near-in areas, and thus, the relative changes are smaller. The largest savings (11 percent or more, although most of these are under 15 percent) are clustered in two areas: 1) near-in areas without direct service to South Station (short total travel times make smaller differences relatively large); and 2) outlying areas to the north served by express bus and commuter rail that would have poor connecting service from Haymarket/North Station to the World Trade Center in the No Action Alternative.

The number of transfers transit riders must make to reach their destinations is another important measure of the perceived quality of the transit service provided that is not captured by travel time measures. However, there is little difference between the alternatives in terms of the number of transfers required to reach the Piers area from any given location. This is because the Piers area transit alternatives are structured to provide only connecting service to the major radial transit lines, rather than direct service from riders' homes.

For trips from all corridors to the World Trade Center, all alternatives require the same number of transfers. For trips to Fan Pier, differences exist among the alternatives in the number of transfers required for some corridors. Riders from the Orange Line, both north and south, are expected to transfer downtown in all the action alternatives; in the No Action Alternative, they are expected to walk from State Street Station. Riders from the Red Line and South Station commuter rail are expected to transfer to the Transitway in all Transitway Alternatives but are expected to walk from South Station in the No Action and Bus/TSM Alternatives. Transfers for riders from the Green and Blue Lines would not differ by alternative. All Green Line West riders are expected to transfer, while Blue Line riders are expected to walk from Aquarium Station.

ES.3.1.2 Cost

Cost is also a major component of transit level of service. For most transit riders to the Piers area, the cost of their transit trip would not vary among the alternatives. Any cost differences among alternatives for an entire trip would result from differing fare and transfer policies of the various Piers area services, as well as the extent to which riders choose to walk across the Fort Point Channel.

For example, since Blue Line riders are expected to walk to Fan Pier from Aquarium Station rather than transfer to a Piers area service, no additional fare would be incurred. Likewise, riders of the Red Line and South Station commuter rail are expected to walk to Fan Pier from South Station. This is because Aquarium and South Stations lie within relatively easy walking distance of Fan Pier. For riders passing through North Station (from the Orange, Green, and commuter rail lines), the North Station shuttle bus fare of $0.60 would apply in all of the action alternatives. In the No Action Alternative, the ridership model projects that these riders would walk to Fan Pier (mostly from State or Government Center Stations), rather than take the circuitous Route 6. From the Green Line West and Orange Line South, riders would take shuttle buses (in the Bus/TSM and MOS Alternatives) or local buses (Route 7 in the No Action Alternative) and pay a $0.60 fare to reach Fan Pier. In the Full Build Alternative, however, these riders would have a free transfer to the Transitway.

For trips to the World Trade Center, transit users are not projected to walk from the downtown stations on the radial transit lines (with the exception of a very few riders in the No Action Alternative who would not be able to use the overcrowded local bus routes). Thus, from all corridors in the No Action and Bus/TSM Alternatives, riders would pay a $0.60 bus fare to reach the World Trade Center. In the MOS Alternatives, Red Line riders would receive a free transfer, while South Station commuter rail riders would have to pay the $0.85 fare to use the Transitway. The free transfer is extended to Green Line West and Orange Line South riders in the Full Build Alternative.

It should be noted that these costs refer only to riders who pay cash fares (approximately 57 percent of MBTA riders today). Holders of monthly passes, except the "subway" and commuter rail passes, would receive free transfers to all Piers area surface bus services. For the Transitway Alternatives, commuter rail pass holders would be allowed free entry into the Transitway instead of paying the $0.85 cash fare. Rapid transit riders would also receive a free transfer to the Transitway.

ES.3.1.3 Comfort

Since the frequency of service provided by each action alternative was designed to be in equilibrium with ridership, no overcrowding on Piers area transit services is anticipated. The limited services provided in the No Action Alternative would cause an increase in walk trips to the Piers area rather than "crush" loads on the bus routes operated under this alternative.

ES.3.2 Transit Ridership and Mode Share

Based upon anticipated development in the Piers area, it is estimated that 67,600 daily person trips would be made into the Piers area in the year 2010 under the lower growth scenario and 90,500 under the high growth scenario. In the a.m. peak hour, 12,200 person trips would be generated to the Piers area in the 2010 lower growth scenario; this figure is estimated to be 18,200 in the 2010 high growth scenario. These estimates reflect all riders using transit for trips to the Piers area regardless of the actual service (Transitway, local bus, shuttle bus, express bus, or walk) used to enter the Piers area.

The No Action Alternative would attract the fewest riders to transit on both a daily and a.m. peak basis. Only 24 percent (21,700) of all daily trips destined to the Piers area in the high growth scenario would be made on the three local bus routes operated in this alternative; this transit mode share is somewhat higher — 25 percent, or 16,800 trips — in the lower growth scenario. In the a.m. peak hour, these routes would attract just 23 percent (4,300) of all 2010 high growth scenario trips to the area. In the lower growth scenario, the a.m. peak hour transit mode share is again higher at 25 percent (3,100 trips). While services provided by the No Action Alternative have the potential to attract a somewhat higher transit ridership than indicated by these ridership projections, the demand during the peak hour would be greater than the maximum feasible capacity of these services. It is not possible to increase these frequencies further since services provided by the No Action Alternative are constrained by the capacity of the MBTA's existing maintenance facilities. As a result, transit ridership in the No Action Alternative is constrained by the capacity of the three local bus routes serving the Piers area.

Among the "action" alternatives (Bus/TSM, MOS, and Full Build), the Bus/TSM Alternative would achieve the lowest transit mode shares in both the a.m. peak hour and daily periods under the high and lower growth scenarios, while the Full Build Alternative would achieve the highest. In the high growth scenario a.m. peak hour, the Bus/TSM Alternative has a transit mode share of 51 percent (9,300 trips), while daily it attracts only 33 percent (29,900) of all trips to the Piers area. Assuming the lower growth scenario, the Bus/TSM Alternative has an a.m. peak hour transit mode share of 43 percent (5,300 trips) and a daily share of 28 percent (19,300 trips). The MOS Alternatives achieve transit modes shares of 59 percent (10,600 trips) and 38 percent (34,100 trips) in the high growth scenario a.m. peak hour and daily, respectively. In the lower growth scenario, these shares drop to 51 percent (6,200 trips) in the a.m. peak hour and to 33 percent (22,000 trips) on a daily basis.

The Full Build Alternative achieves the highest transit mode share of all alternatives analyzed in both periods and in both growth scenarios. In the high growth scenario, the Full Build Alternative achieves a 62 percent transit mode share in the a.m. peak hour (11,200 trips) and 41 percent on a daily basis (37,000 trips). These shares decrease somewhat if the lower growth scenario is assumed: 54 percent (6,600 trips) in the a.m. peak hour and 36 percent (24,400 trips) daily. In the high growth scenario, the Full Build Alternative would have a daily transit mode share for travel to the Piers area that is only 2 percentage points below the projected 2010 transit mode share to downtown Boston. Furthermore, the Full Build Alternative's daily transit mode share for work trips to the Piers area in the 2010 high growth scenario would be virtually the same as that experienced in the CBD.

Transit ridership and mode share by regional corridor varies among the action alternatives, with the MOS and Full Build Alternatives attracting more riders to transit from the Northwest and South/Southeast Corridors than the Bus/TSM Alternative. Transit mode shares from the West and Southwest Corridors vary the most, highlighting the benefits of connections to Boylston and Chinatown Stations enabled by the Full Build Alternative. For example, the Southwest Corridor is projected to have among the lowest transit mode shares under the Bus/TSM and MOS Alternatives, but the highest transit share under the Full Build Alternative.

Transit riders may use any of several transit sub-modes to reach their final destination in the Piers area. They may use the Transitway, shuttle, or express bus services that are offered in the action alternatives, use the supplementary local bus services, or walk directly from a regional transit station located across the Fort Point Channel in downtown Boston (*e.g.*, South Station). Figures ES-3 and ES-4 show the mode and sub-mode of entry for all person trips to the Piers area (including those made by automobile) for the high and lower growth scenarios. It is evident that Piers area transit services play a much more significant role in trips to the Piers area in the Transitway Alternatives (MOS and Full Build) than they do in the Bus/TSM and No Action Alternatives. This increase in the use of transit services translates into fewer automobile trips as well as fewer transit trips that include walking across the channel. The greater role of the Transitway services in the Full Build Alternative, in comparison to the MOS Alternative, is also quite evident. Thus, the Transitway Alternatives not only reduce automobile usage, they also reduce the number of surface buses and provide better service to riders, as evidenced by the significant reduction in riders who walk across the channel to their destinations.

ES.3.3 Productivity of Piers Area Transit Services

Transit ridership and mode share are useful measures of the effectiveness of transit alternatives in meeting the transportation goals for the Piers area. Productivity, on the other hand, is an indication of how efficiently resources are being utilized to provide the transit service. The two most commonly used service productivity measures are passengers per vehicle-hour and passengers per vehicle-mile. Each measure compares the usage of a service with the amount of service provided.

The combined productivity in the high and lower growth scenarios of all surface bus and Transitway services for each alternative was shown previously in Table ES-3. The No Action Alternative would operate with productivities comparable to the Bus/TSM and MOS Alternatives, despite using only standard buses. It should be noted, however, that while No Action productivity is similar to that for the Bus/TSM and MOS Alternatives, total ridership is much less.

While the Bus/TSM Alternative is expected to achieve productivities on a per mile basis that are similar to the No Action Alternative, due to higher operating speeds on the Seaport Access Road and dedicated bus lanes, productivities per hour are expected to be greater. Even though the operating plan for the Bus/TSM Alternative would be almost the same in both scenarios, productivity is expected to be higher in the high growth scenario. The reason for this productivity increase is that several of the shuttle routes, which are assumed to operate at a policy headway in both scenarios, are projected to operate well under capacity in the lower growth scenario but closer to capacity in the high growth scenario.

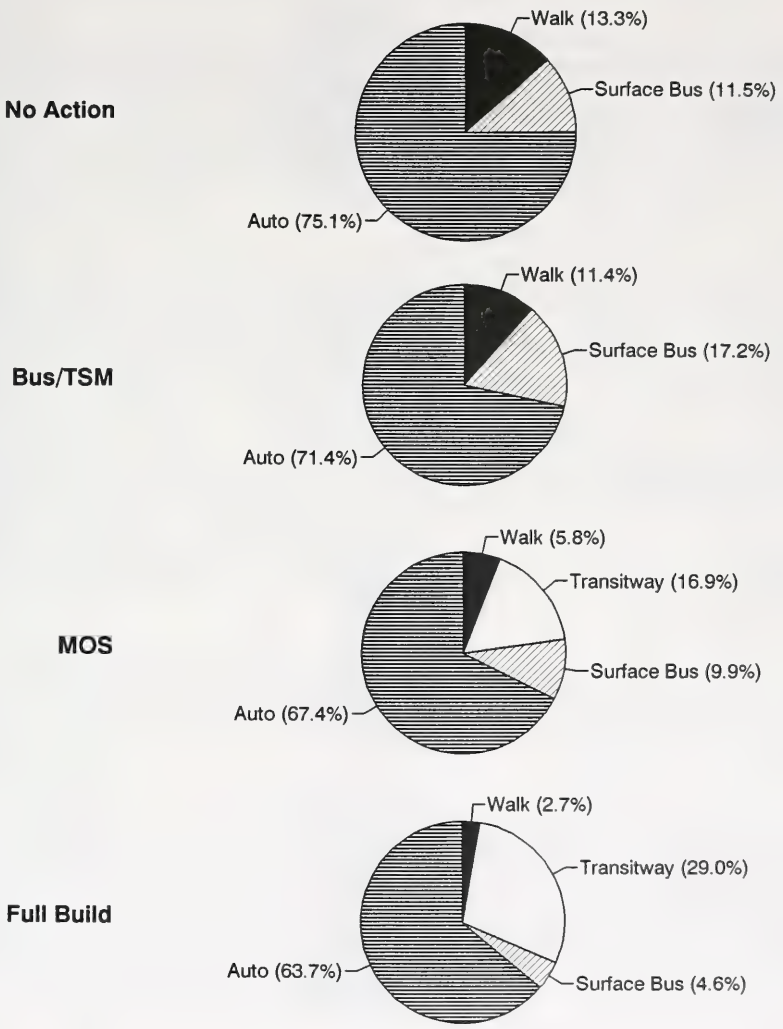
The combined surface and Transitway productivity for the MOS Alternatives is expected to be similar to that for the Bus/TSM Alternative in both growth scenarios since many riders would use the high-frequency Transitway where headways would be based on demand. Combined surface and Transitway productivities for the Full Build Alternative are projected to be the highest of all alternatives in both growth scenarios. This is largely due to the high speed operation of large, heavily-loaded buses in a grade-separated, dedicated right-of-way.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. ES-3
Mode of Entry Into the Piers Area - Daily Trips (2010 Lower Growth)

Year 2010 Lower Growth



Note: percentages may not add to 100% due to rounding

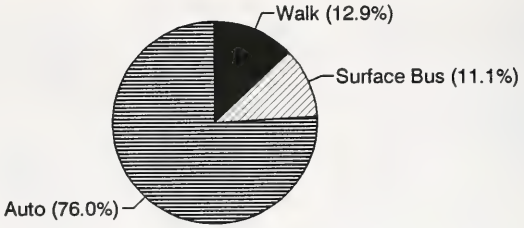
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

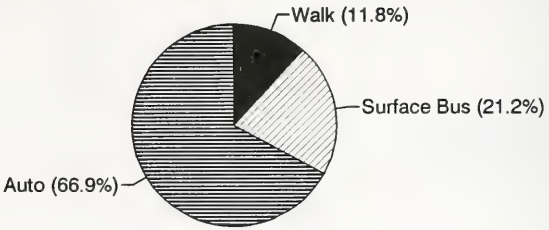
Fig. ES-4
Mode of Entry into the Piers Area - Daily Trips (2010 High Growth)

Year 2010 High Growth

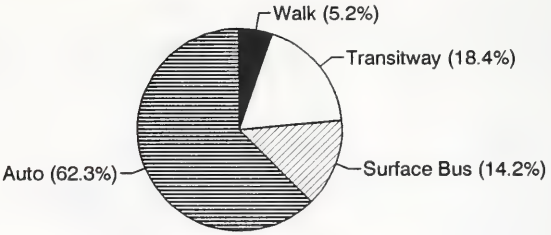
No Action



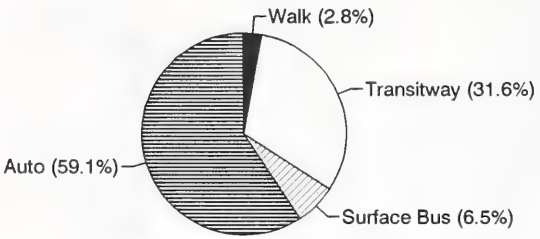
Bus/TSM



MOS



Full Build



Note: percentages may not add to 100% due to rounding

ES.3.4 Traffic Impacts

The increase in the use of transit for trips to the Piers area that would result from each of the action alternatives would result in a reduction in the number of ***vehicle*** trips. Consequently, there would also be reductions in daily automobile vehicle miles traveled (VMT). The greatest reduction is projected to occur under the Full Build Alternative where over ***311,428*** daily vehicle-miles in the high growth scenario, and ***169,786*** in the lower growth scenario, could be saved versus the No Action Alternative. This equals approximately a one percent improvement in total regional VMT.

Traffic level of service (LOS) analyses also exhibit a trend of improving traffic conditions in progressing from the No Action Alternative to the Full Build Alternative. ***Since all intersections operate at LOS C or better under all alternatives in the lower growth scenario, the following discussion summarizes results for the high growth scenario only.*** The No Action Alternative results in the most severe traffic conditions owing to the increase in development and trip generation in the absence of any significant transit improvements. Seven intersections would operate at LOS E or LOS F under the No Action Alternative in the high growth scenario with an average delay of approximately 89 seconds (LOS E) at the Massport Haul Road/D Street intersection.

Although the Bus/TSM Alternative introduces a significant transit component to the project area, its operation involves a substantial increase in bus volumes on surface streets. ***Two*** intersections would still perform at LOS E or LOS F under this alternative in the high growth scenario with an average delay of nearly 66 seconds at the Massport Haul Road/D Street intersection. The Bus/TSM Alternative includes an exclusive bus lane westbound along New Congress Street between West Service Road and D Street in the high growth scenario in order to separate bus and automobile traffic and thus improve bus operating speeds.

The MOS Alternatives provide a more substantial transit operation in the Piers area and reduce surface bus volumes by virtue of the in-tunnel right-of-way. Only ***one*** intersection — Massport Haul Road/D Street — operates at LOS E in the high growth scenario due primarily to the need to operate shuttle buses linking the Piers area to downtown regional transit terminals.

The Full Build is the only alternative that would result in all Piers area intersections performing at LOS D or better in 2010 under the high growth scenario.

ES.4 ENVIRONMENTAL IMPACTS AND MITIGATION

Table ES-4 highlights the social, economic, and environmental impacts of each project alternative. Those impacts are summarized below by impact category.

ES.4.1 Neighborhoods, Land Use, and Economic Activity

The most significant impact of the No Action Alternative on land use and economic activity is the alternative's inability to support the high growth scenario development goals of the South Boston Piers area. The relatively low level of transit service provided by this alternative means that the majority of commuters to the Piers area (75 percent) would drive, causing substantial deterioration of traffic and environmental conditions, particularly in the high growth scenario. In such a situation, the city and state may not be able to approve many of the projects planned for the Piers area. With the No Action Alternative, it is possible that up to 15.3 million square feet of potential development would not be accommodated in the Piers area and may either be lost or redistributed to other sites.

TABLE ES-4: SUMMARY OF SIGNIFICANT SOCIAL, ECONOMIC, AND ENVIRONMENTAL IMPACTS BY ALTERNATIVE

Impact Category	No Action	Bus/TSM	MOS	Full Build
Neighborhoods, Land Use, and Economic Activity	Loss or redistribution of up to 15.3 million square feet of Piers area high growth development	Loss or redistribution of up to 10.1 million square feet of Piers area high growth development	Loss or redistribution of almost one million square feet of Piers area high growth development	Supports full 2010 high growth scenario buildout of the Piers area
Energy	---	Annual energy savings of ***406.2 BTU***	Annual energy savings of ***396.9 (MOS-1) to 349.7 (MOS-2) BTU***	Annual energy savings of ***303.7 BTU***
Aesthetic	Less building mass in Piers area	Bus lane (high growth scenario) on New Congress Street encroaches on landscaped median	For MOS-1, portal at Pittsburgh Street and catenary along New Northern Avenue and New Congress Street would have visual impact; for MOS-2, catenary would have an impact in the easternmost industrial Piers area	Fully underground alignment limits visual impact to limited surface routes in the easternmost industrial Piers area and possibly a limited route to residential South Boston
Air Quality	---	No exceedances of air quality standards	No exceedances of air quality standards	No exceedances of air quality standards
Noise	Severe impacts at ***4*** sites	Severe impacts at 4 sites	Severe impacts at **4** sites	Severe impacts at 3 sites
Vibration	No impact	No impact	Construction-related vibration annoyance caused by Fort Point Channel tunnel crossing	Construction-related vibration annoyance caused by Fort Point Channel tunnel crossing
Ecosystems	No impact	No impact	Temporary impacts during construction	Temporary impacts during construction

TABLE ES-4: SUMMARY OF SIGNIFICANT SOCIAL, ECONOMIC, AND ENVIRONMENTAL IMPACTS BY ALTERNATIVE (continued)

Impact Category	No Action	Bus/TSM	MOS	Full Build
Water Resources	No impact	No impact	Temporary impacts during construction of channel crossing	Temporary impacts during construction of channel crossing
Sediment Disposal	No impact	No impact	Generation of ***184,500 (MOS-1) or 396,500 (MOS-2) cubic yards*** of excavated material	Generation of ***637,500 cubic yards*** of excavated material
Archaeological Resources	No impact	No impact	No impact	Potential impact to as-yet-unknown resources on Boston Common
Historic Resources	No impact	No impact	Temporary impact to granite bulkhead walls of Fort Point Channel	Temporary impact to granite bulkhead walls of Fort Point Channel and Boston Common; permanent impact to Boylston Station
Parklands	No impact	Permanent hindrance of visual and physical access to parklands	Temporary impact to use of Fort Point Channel for recreational boating; permanent hindrance of visual and physical access to parklands	Temporary impact to use of Fort Point Channel for recreational boating and to Boston Common; no permanent impacts

The Bus/TSM Alternative is expected to have three significant impacts on neighborhoods, land use, and economic activity. First, high surface bus volumes operated in the alternative would contribute to traffic congestion on Piers area streets. Given this congestion and related negative environmental impacts, full Piers area buildout forecast under the high growth scenario would be hindered. It is estimated that the Bus/TSM Alternative could result in a loss or redistribution to other areas of up to 10.1 million square feet of potential Piers area development. Second, while construction of a bus lane on New Congress Street would enhance operation of the alternative in the high growth scenario, it would require a taking from the site of the World Trade Center expansion, a project that is already well advanced in the planning stages. Third, Chinatown's neighborhoods would perceive high surface bus volumes (approximately one bus every minute on some streets during the a.m. peak hour) as having a negative impact on neighborhood life, including social cohesion and residential stability.

Similar negative impacts on Chinatown's streets are anticipated in the two MOS Alternatives. In the Piers area, a full taking of Victoria Station would be required; this taking would also be required in the Full Build Alternative. Given the occurrence of significant traffic congestion in both MOS Alternatives in the high growth scenario, a loss or redistribution of just under one million square feet of Piers area development potential could also be expected.

The Full Build is the only alternative that would fully support projected high growth development in the Piers area. Furthermore, the provision of a Transitway tunnel between Boylston and South Stations eliminates negative impacts to Chinatown's neighborhoods and reflects a strong public commitment to the downtown area. ***Although takings/easements would be required to construct the tunnel and subsurface utilities, any existing occupants would be given sufficient time and assistance to relocate, and no economic impact is anticipated.***

ES.4.2 Energy Impacts

In comparison to the No Action Alternative, all of the action alternatives exhibit significant potential for energy savings. For the Transitway Alternatives, energy savings are slightly reduced in comparison to the Bus/TSM Alternative due to the energy required for construction of the tunnel and stations. ***Since implementation of the Transitway results in energy savings, no mitigation measures are planned or considered necessary.***

ES.4.3 Aesthetic Impacts

The future development of the Piers area is, to a large extent, contingent upon enhanced public transit services. Thus, as described in Section ES.4.1, a secondary consequence of the No Action and Bus/TSM Alternatives could be substantially less building mass in the Piers area than might otherwise be built in the future. The bus lane proposed as part of the Bus/TSM Alternative would also impact the BRA's plans for New Congress Street, by displacing curbside parking and reducing the area available for landscaping.

The two most evident aesthetic impacts of the MOS-1 Alternative would be the vehicle portal entry/exit at Pittsburgh Street and trackless trolley catenary extending from the portal eastward through the Piers area. Extension of the Transitway tunnel to the World Trade Center in the MOS-2 Alternative moves the location of the portal to the southerly side of the Massachusetts Port Authority's proposed replacement parking garage. The MOS-2 portal is not expected to pose any significant visual intrusion. In addition, trackless trolley catenary impacts would be substantially reduced as compared to the MOS-1 Alternative because of the extended underground alignment between Fan Pier and the World Trade Center.

Given its fully underground alignment, the visual and aesthetic impacts of the Full Build Alternative would be minor, limited to specific sites along the alignment where station elements penetrate to street level or where subsurface construction occurs beneath existing buildings or parcels. Station elements that penetrate to street level and that could cause visual impacts include entrances to stairways and escalators, elevators, and ventilation shafts. Other elements that would have visual impacts are the Transitway portal at D Street, overhead trackless trolley catenary, and the storage and maintenance facility. ***Appropriate***

design of all surface system elements incorporated into the streetscape can enhance the visual impact. Design treatments will be stipulated in Transitway construction contracts to minimize the visual impacts of the Transitway portal at D Street, overhead catenary in the eastern Piers area, and the storage and maintenance facility.

ES.4.4 Air Quality Impacts

No exceedance of the one-hour or eight-hour carbon monoxide (CO) national and Massachusetts air quality standards under worst case conditions are expected for any of the alternatives in either growth scenario. Furthermore, each action alternative would be expected to generate a slight decrease in the total daily emissions burden of CO, non-methane hydrocarbons, and nitrogen dioxide. The least reduction would be associated with the Bus/TSM Alternative, with a slightly greater reduction occurring under the MOS Alternatives. The greatest level of reduction would occur with the Full Build Alternative.

During construction, traffic mitigation measures will be designed to keep traffic flowing in and around construction sites, thereby minimizing idling and congestion which contribute to localized air quality impacts.

ES.4.5 Noise and Vibration Impacts

ES.4.5.1 Noise

The Full Build Alternative generates the least number of severe noise impacts of all the alternatives. Of the twelve receptor sites analyzed, only ***one*** would be severely impacted in the Full Build Alternative in the opening year and three in 2010. The increase reflected in the year 2010 is attributable to increased traffic volumes and related activity as caused by high growth scenario development in the project area. These increases are relatively uniform across all the alternatives. The Bus/TSM and MOS Alternatives exhibit greater noise impacts than the Full Build Alternative due to their higher volumes of automobiles and surface bus traffic.

Mitigation measures to reduce noise levels during construction will be identified in construction contract specifications. These measures may include limiting construction to normal daytime hours; ensuring that all diesel power equipment is properly muffled; erecting temporary noise barriers as needed; providing specific routes for truck movement to and from construction sites; limiting removal of muck from tunneling operations to specific hours; and adhering to City of Boston Air Pollution Control Commission construction noise ordinances. The maintenance of tunnel floors will minimize the groundborne vibration and noise generated by underground electric bus operations.

ES.4.5.2 Vibration

No significant vibration effects are anticipated as a result of the operation of any of the alternatives. Construction of the Transitway Alternatives is not expected to cause ground vibration at levels that could cause structural damage. However, pile driving could potentially cause vibration annoyance at four buildings near the Fort Point Channel: Harbor Plaza, Hook Lobster, the Computer Museum end of Museum Wharf, and a building on Northern Avenue owned by Stone and Webster. Pile driving operations could be expected to occur for a maximum of two months, producing building vibration that may be characterized as "easily noticeable." Potential methods of vibration mitigation at these sites would include pre-auguring and the use of low-displacement bearing piles.

ES.4.6 Ecosystems

The major potential impacts on ecosystems would originate from construction related activities within the Fort Point Channel associated with the Transitway Alternatives. These impacts could include temporary disturbances to the floodplain, channel banks, and wildlife use of the channel during tunnel construction. On land, the most significant impact would be associated with rodent control; a baiting and monitoring

program would be implemented to control rodent infestation. There would be no permanent impacts caused by the operation of any of the alternatives. There would be no permanent or temporary impacts to upland vegetative or wildlife communities.

Work within and adjacent to the Fort Point Channel and filled tidelands would require state permits, licenses, and/or approvals pursuant to the Massachusetts Wetlands Protection Act, Chapter 91, Massachusetts Coastal Zone Management (MCZM), and Water Quality Certification. Compliance with Chapter 91 and MCZM as they relate to use and protection of the waterfront and coastal zone is reflected by the improved public access provided by the Transitway.

While construction activities would not cause the significant displacement of existing rodent populations, the construction of the storage and maintenance facility could result in localized rodent disturbance. The degree of such disturbance would be related to the amount of habitat disruption either through demolition of existing structures or the excavation of new foundations. A rodent control program will be implemented to mitigate these effects.

If the maintenance facility is constructed at the Site A option, displacement of water dependent accessory uses would be mitigated by relocation assistance.

ES.4.7 Water Resources

No significant impacts to water resources as a result of implementation of either the No Action or Bus/TSM Alternatives are anticipated. Potential impacts to water resources of the Fort Point Channel as a result of implementation of the MOS or Full Build Alternatives would include resuspension of bottom sediments, constriction of channel flow, and decreased navigability. Given that the Transitway tunnel would ultimately lie well beneath the bottom of the channel, however, all of the potential impacts would be construction-related and short-term in nature. No long-term or permanent change to the existing physical or hydrological characteristics of the channel are anticipated.

If the modified sunken tube method is used to construct the Transitway across the Fort Point Channel, a number of measures can be taken individually or collectively to mitigate the impacts of increased suspended solids. These include use of closing clamshell dredge buckets; silt curtains; reduced dredging time; alternative seawater sources; and temporary filtration. The use of cofferdams would prevent the turbidity impacts associated with open water dredging. Water quality impacts would be limited to minor, localized short-term resuspension of bottom sediments during the placement and removal of cofferdams. One half of the channel would always remain open for tidal flushing and navigation under both construction methods.

Due to the generally shallow groundwater levels in the project area, and as a result of normal, construction site stormwater accumulation, some dewatering of the Transitway excavations will be required during construction. Steps will be taken to minimize dewatering in order to prevent drawdown of the existing groundwater table and to reduce the amount of groundwater and stormwater discharged to surface waters.

Based on anticipated dewatering rates, no groundwater injection is anticipated. Discharge of pumped groundwater to local storm drains will be subject to National Pollution Discharge Elimination System (NPDES) permit review by EPA and a dewatering permit from the Boston Water and Sewer Commission (BWSC, Article II, Section 8 of the Commission's Sewer Use Regulations). These permitting processes will establish control measures necessary to prevent water quality impacts to the downstream receiving waters. The storage/maintenance facility which would be needed under each Transitway Alternative would be subject to construction and post-construction NPDES permits.

ES.4.8 Sediment Disposal

Construction of one of the project alternatives could involve a combination of cut-and-cover excavation, tunneling, and dredging. Excavated volumes, including fill, native sediments, and dredged materials, vary greatly from virtually none in the No Action Alternative to approximately ***637,500 cubic yards*** in the Full Build Alternative. ***The sediment characterization program completed for the DEIS/SDEIR indicated that approximately 8,500 cubic yards of this material are likely to require disposal as a hazardous material; approximately 35,000 cubic yards of material would be suitable for ocean disposal at the Massachusetts Bay Disposal Site; an estimated 132,700 cubic yards would be suitable for reuse as project backfill; and the remainder would meet the requirements for reuse or disposal in local landfills.***

ES.4.9 Archaeological Resources

The Full Build is the only alternative likely to have an impact on potentially significant archaeological resources, should they exist. The extreme western end of the Full Build Alternative would extend into an area of the Boston Common where potentially significant as-yet-unknown archaeological resources may be preserved. Additional archaeological investigations would be needed to determine the location, extent, internal components, temporal affiliation, and significance of any sites existing within this sensitive area. A determination of either No Effect, No Adverse Effect, Conditional No Adverse Effect, or Adverse Effect can be made when the resources and project impacts are known. These investigations would likely be performed immediately in advance of any construction activity.

ES.4.10 Historic Resources

While no impacts to historic resources are expected as the result of operation of any of the transit alternatives, construction of the Transitway Alternatives could affect resources along the alignment. The only significant impact of the MOS Alternatives to historic resources in the Piers area would be the temporary removal of the granite bulkhead walls on either side of the Fort Point Channel at the tunnel crossing points. These walls would be rebuilt after construction (except within the confines of the tunnel). There would be no permanent impact to the Fort Point Channel. **On the western side of the Fort Point Channel, the Russia Wharf Buildings would be underpinned to permit construction of the Transitway tunnel below the structure. Such underpinning would greatly enhance the buildings' structural support.** Protection of the historic resources along Atlantic Avenue is the responsibility of the CA/T Project. In the Full Build Alternative, extension of the Transitway tunnel from South Station to Boylston Station would also have impacts on historic resources in the downtown area.

Impacts to the Boston Common during construction of new Transitway platforms and a turnback loop below the existing Boylston Station would be temporary. One lane of traffic would be detoured onto the Lafayette Mall of the Boston Common during construction of slurry walls in Tremont Street. Approximately six of the 1960s vintage planters along the western side of Tremont Street would have to be removed, but they would be restored or other landscaping treatment applied in accordance with the Boston Common Management Plan. A permanent effect would be the interconnection of the proposed Transitway station and existing historic Boylston Station (a National Historic Landmark) above it by means of stairs, passageways, and escalators or elevators.

A Memorandum of Agreement (MOA) has been developed between the FTA, MHC (in its capacity as the SHPO), and the Advisory Council of Historic Preservation, with concurrence by the MBTA and the Boston Landmarks Commission. This agreement establishes measures intended to avoid, minimize, and/or mitigate impacts to historic and archaeological resources, including the following:

- ***Prior to alteration of any significant properties, a historic survey will be conducted to document the pre-alteration condition of the property.***

- ***A Project Conservator shall be appointed to the project design team by the MBTA to ensure that adverse construction impacts on all historic properties are identified***

early in the project design stages, and are either avoided, minimized, or mitigated through appropriate preliminary and final design solutions.

- ***An architectural firm with experience with historic preservation shall be appointed to the project design team by the MBTA to assist in the design of building elements associated with the project that affect historic resources.***

- ***The granite bulkhead walls on either side of the Fort Point Channel at the Transitway tunnel crossing points shall be reconstructed in such a manner as to ensure that the existing appearance and function of the bulkheads are maintained.***

- ***The interior of Boylston Station shall be rehabilitated following construction of the project in conformance with the Secretary of the Interior's Standards for Rehabilitation of Historic Structures.***

- ***Further intensive archeological investigations shall be undertaken prior to construction in the vicinity of Boylston Station and the Central Burying Ground***

ES.4.11 Parklands

Due largely to the limited existing parkland in the project area, no transit alternative is expected to have any direct (*i.e.*, land taking) impact. All but the No Action Alternative, however, would have some indirect impacts to either existing or planned parklands. In general, these indirect impacts would be felt as a result of either the presence of fixed facilities or the operation of surface buses.

Surface passenger facilities associated with the Bus/TSM Alternative consisting of shelters, street furniture, bus berths, and pullouts on New Congress Street and New Northern Avenue would reduce public space that has been designated for landscaping and other boulevard features. Such features are intended to provide visual relief to the developed portion of the Piers area which currently has very little greenery. In addition, surface buses operating through the Chinatown/Midtown District could create safety problems for children trying to reach neighborhood parks and playing fields.

Surface bus volumes at approximately one bus per minute operated in the MOS-1 Alternative during the a.m. peak hour could make it difficult to reach Harborwalk and the proposed parks at Fan Pier. In both MOS Alternatives, similar surface bus volumes could negatively impact access to and enjoyment of parklands and open space in the Chinatown/Midtown District.

The fully underground alignment of the MOS-2 and Full Build Alternatives in the Piers area eliminates the negative impacts to parklands and open space that occur in the MOS-1 Alternative. Construction activity near Boston Common in the Full Build Alternative would temporarily affect both access to and use of a small portion of the Common. There would be no long-term or permanent impacts, and some betterments are possible.

Detours and re-routings, which will be identified as final design and construction staging plans are developed, will be coordinated with the Boston Transportation Department (BTD) to ensure that safe, efficient vehicular and pedestrian access to the waterfront is provided throughout the construction period. Pedestrian access to Boston Common and the Lafayette Mall will be ensured as the new station's design and construction program are further developed. In developing construction programs, the MBTA will work closely with the Boston Parks and Recreation Department as well as BTD. The MBTA has substantial construction experience in intensively used urban areas and is committed to safe, convenient pedestrian and passenger access to the Boston Common and Boylston Station.

Because the new Transitway station will be constructed one level beneath the existing Boylston Station, construction will occur at a very deep level — approximately 40 feet underground — and

will be hand mined. Given this deep construction, ground water levels should not be lowered and the root systems of the few trees in the construction area would not be damaged.

Most of the affected plant life consists of either planters or small shrubs. Restoration of these plants and the Lafayette Mall will be consistent with the Boston Common Management Plan, and the MBTA will work closely with the Boston Parks and Recreation Department and the Boston Landmarks Commission to ensure that there is no permanent damage to the Common. Protection of the Common is a major City of Boston goal in this and other construction projects such as those at Park Station.

ES.4.12 Traffic Impacts Mitigation During Construction

For all areas of construction traveled by the public, detailed traffic maintenance plans will be developed and implemented by the MBTA's designers and construction contractors. All plans and measures to be adopted will be the result of ongoing coordination with the BTD and other city and state agencies having jurisdiction. In areas of joint construction with the CA/T Project, mitigation measures will be consistent with provisions specified by that project. All provisions for access will comply with applicable regulations pertaining to persons with disabilities, including Americans with Disabilities Act guidelines.

ES.5 EVALUATION OF ALTERNATIVES

The evaluation of transit alternatives involves the collection, organization, and analysis of an abundance of technical and other information. To assist decisionmakers in assessing the relative pros and cons of each alternative without becoming mired in such information, an evaluation framework has been established for this project. This framework helps identify key differences among alternatives according to three evaluation criteria: (1) financial feasibility, the ability of known funding sources to meet anticipated capital and operating funding requirements of the alternatives; (2) effectiveness, the degree to which the alternatives assist in the attainment of transportation and other planning goals; and (3) cost-effectiveness, the cost associated with achieving the benefits of each alternative.

ES.5.1 Financial Feasibility

A financial feasibility analysis was conducted to assess the financial condition of the MBTA and its capacity to undertake the South Boston Piers Transit Project. Assuming average annual increases of no more than ***5.1 percent*** in total state assistance and 80 percent federal funding, the projected revenues available to the MBTA are sufficient to cover the costs of operating and maintaining the current transit system and committed transit investments (including the Old Colony Project), with sufficient revenue remaining to cover the net operating costs of the Full Build Transitway and the debt service on the local share of capital investment costs.

The FTA has advised the MBTA that the entire $278 million earmarked for this project in the Intermodal Surface Transportation Efficiency Act (ISTEA) may not be available over the projected implementation period. The Section 3 share of all projects earmarked in ISTEA exceeds the total amount authorized. Furthermore, the actual appropriations for this program over the first two fiscal years have been less than the authorized levels. A hypothetical case was examined where federal funds would be available for only 50 percent ($184 million) of the costs of MOS-2 over the period 1993 through 2000. The increased local share could be accommodated within the projected implementation schedule without exceeding the ***5.1 percent*** growth rate for state assistance, although this may require the authorization of the state legislature for additional bonding authority. Alternatively, the implementation schedule could be extended consistent with existing bonding authority levels. This reduced federal participation would result in increased costs to the MBTA and the state, and would reduce the funds available for other transit investments in Massachusetts, but would not make the project infeasible, as defined in the financial analysis.

A finance plan will be developed for the locally preferred alternative. The MBTA proposes to pay the capital costs of the locally preferred alternative selected for the South Boston Piers Transit Project from two sources: (1) FTA Section 3 new start funds and (2) MBTA bonds. All operating costs, as well as the debt service on MBTA bonds, would be part of the MBTA annual budget, and would be paid through established means. Table ES-6 shows capital funding requirements and sources for each alternative inflated to year-of-expenditure dollars.

TABLE ES-6: CAPITAL FUNDING REQUIREMENTS AND SOURCES (millions of year-of-expenditure dollars)

Alternative	*Federal Grants*	*MBTA Bonds*	*Total Capital*
Bus/TSM	*53.5*	*13.4*	*66.9*
MOS-1	*261.3*	*65.3*	*326.6*
MOS-2	*350.7*	*87.7*	*438.4*
Full Build	*593.0*	*148.2*	*741.2*

Due to changes in the alignment and implementation schedule since the project earmark was authorized, however, the $278 million is insufficient to cover the full 80 percent of the MOS-2 project costs; it will be sufficient to cover roughly 64 percent of the initial implementation phase. The MBTA will request additional federal funds to cover this shortfall in the proposed ISTEA technical correction bill in 1994, which will reauthorize earmarked projects. If this funding is not provided, the implementation schedule will be extended commensurate with the state's ability to secure alternative sources of funding.

Furthermore, although the 1991 Act did not fund projects beyond 1997, the financial analysis assumes that subsequent authorization acts will provide federal funds for the second phase of the project — Full Build — between South Station and Boylston Station at the same 80 percent share. Again, should federal funding beyond the earmarked $278 million not be provided, then the construction schedule of the Full Build Transitway would need to be extended until new sources of funding are identified. At the same time, the MBTA will seek to identify possible project cost savings through value engineering.

ES.5.2 Effectiveness

Using regional planning goals as a basis, the MBTA has established several goals specific to the South Boston Piers/Fort Point Channel Transit Project. These goals were developed through an extensive inter-agency and community participation process and provide a basis for evaluating the effectiveness of alternative improvements to transportation services and facilities in the South Boston Piers area.

Project goals are organized into four broad categories: user benefits, economic development, environmental sensitivity, and system performance. These categories represent the most basic requirements of the transit project and help ensure that project goals which fully address such requirements are developed. A greater level of specificity is reflected in the objectives aimed at achieving each goal. Finally, measures of effectiveness (MOEs) relate recognizable and measurable data to each project objective. MOEs provide the means by which the effectiveness of each alternative — ability to achieve

project goals and objectives — is quantified. Comparison among alternatives is also enabled by the use of MOEs.

ES.5.2.1 User Benefits

The goal associated with the user benefits category is to improve transit service to the Piers area. Three objectives aimed at achieving this goal are as follows:

- Maximize use of public transportation into and out of the Piers area
- Minimize overall travel time to the Piers area
- Maximize convenience of transit service for Piers-bound travelers

Ridership and travel time savings are the two MOEs used to assess user benefits. As shown previously in Table ES-3, the Full Build Alternative outperforms all other alternatives in this category with the highest transit mode share and the greatest savings in total systemwide travel time in both growth scenarios.

ES.5.2.2 Economic Development

The goal of this category is to enable future economic expansion of the South Boston Piers area. Two objectives relevant to this goal are as follows:

- Maximize Piers area development that can occur without unacceptable traffic consequences
- Maximize access to development in the Piers area

MOEs used to assess each alternative's attainment of these two objectives are square feet of development allowable without degrading traffic level of service (LOS) below D at Piers area key intersections, and daily transit mode share to the Piers area.

As noted above, the Full Build Alternative achieves the highest transit mode share of all alternatives considered. The Full Build Alternative is also the only alternative that could support the full high growth scenario development projection for the Piers area. Moreover, future conversion of the Transitway could support an additional 7.1 million square feet of development.

The Bus/TSM and No Action Alternatives, however, could require the elimination or relocation of a significant amount of development throughout the Piers area. This is due to unacceptable traffic conditions in both alternatives and the inability to expand capacity through a future conversion to light rail. The Bus/TSM Alternative is estimated to support only 18.7 million square feet of development, 14 percent below the planned high growth scenario development projection and 35 percent below the level supportable by light rail operation. The No Action Alternative supports even less development; only 13.5 million square feet of high growth development could be supported in the Piers area under the No Action Alternative. This represents a loss or reduction of 38 percent of the official 2010 Piers area development projection and more than half of future development potential.

ES.5.2.3 Environmental Sensitivity

Project goals for this category are: (1) mitigate potential traffic problems in the Piers area generated by projected development; (2) minimize degradation of the natural environment; and (3) preserve cohesion of existing neighborhoods and communities. Associated objectives are as follows:

- Minimize overall traffic volumes into and within the Piers area
- Minimize traffic delays at specific locations

- Minimize air quality degradation in the Piers area
- Minimize regional air quality degradation
- Minimize the creation of barriers or undesirable visual intrusion

MOEs used to assess the ability of each alternative to attain these goals and objectives focus on traffic conditions and their effect on access and the social and natural environment.

In progressing from the No Action to the Full Build, the alternatives demonstrate an improvement in on-street traffic conditions with the attendant improvement in congestion and air quality. The MOS and Full Build Alternatives, by virtue of providing an underground transit right-of-way, also offer significant reductions in on-street transit encumbrances such as bus layovers in commercial and residential areas.

ES.5.2.4 System Performance

The two goals in the system performance category — (1) provide adaptable and reliable transit service and (2) provide efficient and productive transit service — have four associated objectives:

- Provide the opportunity for expansion to meet future/changing needs in the Piers area
- Maximize service performance by providing schedule reliability and safety
- Maximize labor productivity
- Maximize service productivity

System expansion can refer to both the possibility for enlarging the service plan and service area associated with the project alternatives, and it can also be applied to physical expansion of the fixed facilities that are provided under each alternative. The No Action Alternative, by virtue of having no new capital facilities, can be considered only in terms of service expansion. However, since this alternative is already severely constrained by its inability to provide the requisite bus maintenance and storage facilities, any future service expansion would have to occur by sacrificing other existing MBTA services.

The Bus/TSM Alternative offers the potential for expansion of on-street bus operations in the service area. However, traffic analysis suggests that expansion of such services would incur negative operational impacts in terms of additional traffic delays and saturation of designated bus loading and layover sites. Both the Bus/TSM and No Action Alternatives would forever eschew the ability to provide a designated grade-separated transit right-of-way.

The various Transitway Alternatives would provide much better opportunities for future system expansion. MOS-1 would at least provide a minimal grade-separated right-of-way by virtue of the tunnel segment between South Station and Fan Pier/Courthouse. Physical expansion in the Piers area would require disruptive tunnel construction under the newly constructed New Northern Avenue, Seaport Access Road Ramp F, and the Massport replacement parking garage at World Trade Center. Such construction, if feasible and acceptable to the affected properties, could prove to be economically prohibitive. Lack of an underground right-of-way to Boylston Station could similarly result in construction constraints based on new building development in the contemplated right-of-way. Service expansion for MOS-1, absent physical expansion of the tunnel, would require additional bus movements at the somewhat unsatisfactory portal location alongside New Northern Avenue at Fan Pier.

Both MOS-2 and the Full Build Alternative would better provide for future expansion of services in the Piers area by providing a portal location at D Street, easily accessed from the Third Harbor Tunnel and residential South Boston. Transitway tunnel capacity could be enhanced by upgrading of vehicle control/signalization systems to permit extensive vehicle platooning operations. In the downtown area, MOS-2 would incur the same extension concerns as would MOS-1. All Transitway Alternatives would, by

virtue of the tunnel design standards, have the potential to accommodate substantial capacity/service expansion if converted to light rail operation. The Full Build Alternative would seem best suited to such a conversion since a connection to the Central Subway at Boylston Station (albeit with significant track and tunnel modifications) would permit numerous through-routing service plans which would not be possible with an isolated light rail line.

The reliability of a service is dependent on several factors. The factor that would vary the most across the alternatives would be the extent to which service is provided in an exclusive, weather-protected right-of-way, free from interfering traffic and unfavorable weather conditions. This measure can also be an indicator of safety. Potential reliability was measured by the number of passenger-miles occurring in exclusive, weather-protected right-of-way. The Full Build Alternative would produce 71,900 such passenger-miles in 2010 under both growth scenarios, the most of any alternative considered. The MOS-2 Alternative is projected to produce the next highest number of 26,000 passenger-miles, while the MOS-1 Alternative would be third with 14,800 passenger-miles; again, there is no difference in this measure between the high and lower growth scenarios. The Bus/TSM Alternative would provide some service on short decked portions of the Seaport Access Road and some service on an exclusive bus lane (three blocks) in the Piers area in the high growth scenario; however, these limited facilities would not be comparable to an exclusive transit-operated tunnel right-of-way. The No Action Alternative would not include any service on exclusive, weather-protected right-of-way.

Labor productivity is measured as daily passengers per operator. It is projected to be highest for the Full Build Alternative with 548 daily passengers per operator in 2010 on all services combined. This includes a productivity of 879 daily passengers per operator on Transitway services and lower productivities on surface bus services. The productivity of the MOS Alternatives is projected to be second highest at 447 daily passengers per operator, including 799 passengers per operator on Transitway services. The Bus/TSM Alternative is projected to have the lowest labor productivity of the action alternatives with 417 daily passengers per operator, all on surface buses.

Service productivity is also projected to be highest for the Full Build Alternative in both growth scenarios as measured by a.m. peak hour passengers per vehicle-hour and a.m. peak hour passengers per vehicle-mile. These measures were shown previously in Table ES-3.

In the 2010 high growth scenario, the Full Build Alternative achieves productivities of 158 passengers per vehicle-hour and ***21.0*** passengers per vehicle-mile; these productivities are estimated at ***145*** passengers per vehicle-hour and ***20.3*** passengers per vehicle-mile in the 2010 lower growth scenario. The productivity of the MOS Alternatives as measured by passenger per vehicle-hour is projected to be second in the high growth scenario with ***103*** passengers. However, the Bus/TSM is slightly more productive than the MOS Alternatives in terms of passenger per vehicle-mile at ***15.7*** passengers. In the lower growth scenario, the MOS Alternatives achieve better productivities than the Bus/TSM Alternative according to both measures. The No Action Alternative has the lowest productivity of all alternatives in both growth scenarios.

ES.5.3 Cost-Effectiveness

The cost-effectiveness of each alternative was measured using two indices: the new trip index and the user benefit index. The new trip index measures the additional capital and operating cost per new passenger attracted to the transit improvement using the Bus/TSM Alternative for comparison. Ridership is used as a proxy to measure many of the benefits of a transit alternative because it is an easily quantifiable representation of the improvements provided by the alternative. The user benefit index relates the costs of building and operating an alternative with the user benefits (*i.e.*, time and cost savings) accruing from that alternative. The resulting indices of cost-effectiveness are shown for the Transitway Alternatives in Table ES-7.

TABLE ES-7: COST-EFFECTIVENESS INDEX RESULTS

Alternative	New Trip Index ($/new trip)		User Benefit Index ($/hour)	
	Lower Growth	High Growth	Lower Growth	High Growth
MOS-1	12.97	7.31	21.30	12.12
MOS-2	15.65	8.68	25.32	14.04
Full Build	10.11	6.84	15.55	10.47

The new trip index results show that the Full Build Alternative would achieve the best cost-effectiveness in both the lower and high growth scenarios. The Full Build Alternative achieves a somewhat better new trip index than the MOS-1 Alternative, despite the substantial capital cost of the tunnel segment to Boylston Station. The additional ridership resulting from connections to the Green and Orange Lines at Boylston and Chinatown Stations adds substantially to the number of new riders attracted to the Full Build Alternative in comparison to the less extensive MOS Alternatives.

The MOS-2 Alternative would be the least cost-effective of the alternatives. Since no rider benefits are attributed to the tunnel section between Fan Pier/Courthouse and the World Trade Center provided by the MOS-2 Alternative relative to the MOS-1 Alternative, the additional capital costs are overriding.[7] It should be noted that the major benefits of the extended tunnel in the MOS-2 Alternative — reduced surface traffic and the provision of floor level platform enclosed boarding areas — are not benefits that can be fully captured in either the travel time savings or new riders component of the cost-effectiveness index. The index for MOS-2 compared with MOS-1 measures only the small savings that would be experienced by several thousand riders daily.

Comparing the new trip index estimates for the two growth scenarios, the impact of lower and high levels of development on cost-effectiveness can be determined. As would be expected, cost-effectiveness improves with greater levels of development. At the high growth level, the indices for the MOS-1 and Full Build Alternatives are only ***47 cents*** per rider apart, with the Full Build the more cost-effective. At the lower growth level, the Full Build Alternative has an advantage of over ***$2.86*** per rider. There is a good reason for this result. The MOS-1 Alternative serves Green and Orange Line transfers on separate bus services, while the Full Build Alternative serves these riders on the same services as Red Line and South Station commuters. As a result, more of the MOS-1 service operates at policy headways when total demand for service drops. The result is higher operating costs per passenger for the MOS-1 Alternative. In addition, the presence of express buses in the high growth scenario for all action alternatives diminishes the difference in cost effectiveness.

The user benefit indices also show the Full Build Alternative to be the most cost-effective in both growth scenarios. The MOS-1 and Full Build Alternatives are closest in cost-effectiveness in the high growth scenario and show a greater divergence in the lower growth scenario.

[7] It was an assumption of the ridership estimating methodology that the tunnel section between Fan Pier and the World Trade Center would not impact ridership.

ES.5.4 Summary of Trade-Offs Between Alternatives

The purpose of the trade-off analysis is to highlight the key differences among the alternatives based on the project's evaluation criteria. These differences are presented in terms of trade-offs among the criteria.

ES.5.4.1 No Action versus Action Alternatives

The No Action Alternative includes existing and committed transportation facilities in conjunction with a minimal increase in existing transit services. Consequently, it would have the lowest cost among the alternatives considered. The No Action Alternative would not provide additional travel options nor would it improve access to the Piers area from downtown Boston and the regional corridors. Travel times would therefore not be reduced. The No Action Alternative would result in unacceptable levels of traffic congestion and the attendant air quality concerns. High growth scenario development in the Piers area would thus need to be constrained to mitigate these problems. Overall, this alternative would not support the economic development and transportation needs of the Boston metropolitan area.

ES.5.4.2 Bus/TSM versus Transitway Alternatives

In comparing all of the action alternatives, the Bus/TSM Alternative would result in the lowest capital and operating cost outlays. While the Bus/TSM Alternative would increase travel options, it would not adequately reduce roadway congestion and would result in limitations on Piers area high growth scenario development. Deficiencies in the Bus/TSM Alternative are reflected by the fact that the MOS and Full Build Alternatives would further reduce daily Piers area auto trips by 3,000 and 5,100, respectively, as compared to the Bus/TSM Alternative.

The Bus/TSM Alternative can be viewed as an interim staging option that provides improved transit service to the Piers area while foregoing the substantial capital investment required for the Transitway Alternatives. The provision of on-street passenger facilities and a new bus storage and maintenance facility would still represent a significant capital investment in transit infrastructure in the Piers area. This course of action has an inherent risk due to the possibility that the TSM services would not be able to accommodate major development in the Piers area, with the result that development would be underserved by transit. Should the TSM services eventually become unable to meet the transit needs of the Piers area, it would be possible to then consider construction of the underground Transitway. However, construction of the Transitway with much development already in place would likely result in extensive disruptions to utilities, traffic, and access to businesses in the Piers area. These factors, combined with the need to retrofit the Transitway tunnel into the depressed Central Artery alignment would result in significant increases in construction schedules and costs.

ES.5.4.3 MOS versus Full Build Alternative

Of the three Transitway Alternatives, MOS-1 (South Station to Fan Pier) would require the least capital and operating funds. However, the MOS-1 Alternative would not offer the non-disruptive Piers area service expansion possibilities of the MOS-2 and Full Build Alternatives. The minimal MOS-1 tunnel would result in lower ridership (as compared to the Full Build Alternative) and greater on-street bus volumes, thereby perpetuating traffic congestion and a limitation on development in the Piers area in the high growth scenario. Irrespective of the development scenarios under consideration, the MOS-1 tunnel portal and "temporary" surface station located adjacent to the new Federal Courthouse at Fan Pier would interfere with pedestrian and vehicular movement at this location. Subsequent extension of the tunnel to World Trade Center would require extensive reconstruction and disruption at the Fan Pier Station site and would also be disruptive along the entire length of New Northern Avenue.

However, given the uncertainties in the intensity and timing of Piers area development, the MOS-2 Alternative can be viewed as an acceptable staging option in which the investment in transit infrastructure can be made as demand develops. The MOS-2 Alternative also does not raise the near-term financial feasibility questions associated with the Full Build Alternative, particularly as concerns the present shortage of federal Section 3 new start funds. Both the MOS-2 and Full Build Alternatives would provide greater

travel time savings and larger transit ridership. The Full Build Alternative would incrementally outperform the MOS-2 Alternative in these categories, and it is the only alternative that would result in acceptable Piers area traffic conditions under all development scenarios. Consequently, the Full Build Transitway is the only alternative that would fully and consistently support the development and transportation objectives of the South Boston Piers/Fort Point Channel Transit Project.

ES.6 DECISIONS REMAINING

Two key decisions remain to be made prior to implementation of the Full Build Transitway. The first is whether to take or underpin the New England Seafood Center. Construction of the Transitway tunnel beneath the Seafood Center would be feasible if the building is underpinned. However, in consideration of near- and long-term land use plans in the vicinity of the Center, which may entail its future taking, it may be prudent to take the building as part of the Transitway Project. The decision whether to take or underpin the Seafood Center will involve coordination with MHD, Massport, the City of Boston, and Center occupants. It is expected that these other public agencies, should they identify and justify sufficient cause to take the Center, will share in all costs associated with (1) relocation of Center occupants; (2) demolition of the existing structure; and (3) surface restoration of the parcel.

The second decision involves selection of the site for the Transitway storage and maintenance facility. Site selection for the facility will involve close coordination between the MBTA and Massport. It is expected that this decision will be made prior to further design of the facility.

CHAPTER ONE
Purpose and Need

CHAPTER 1: PURPOSE AND NEED

1.1 BACKGROUND

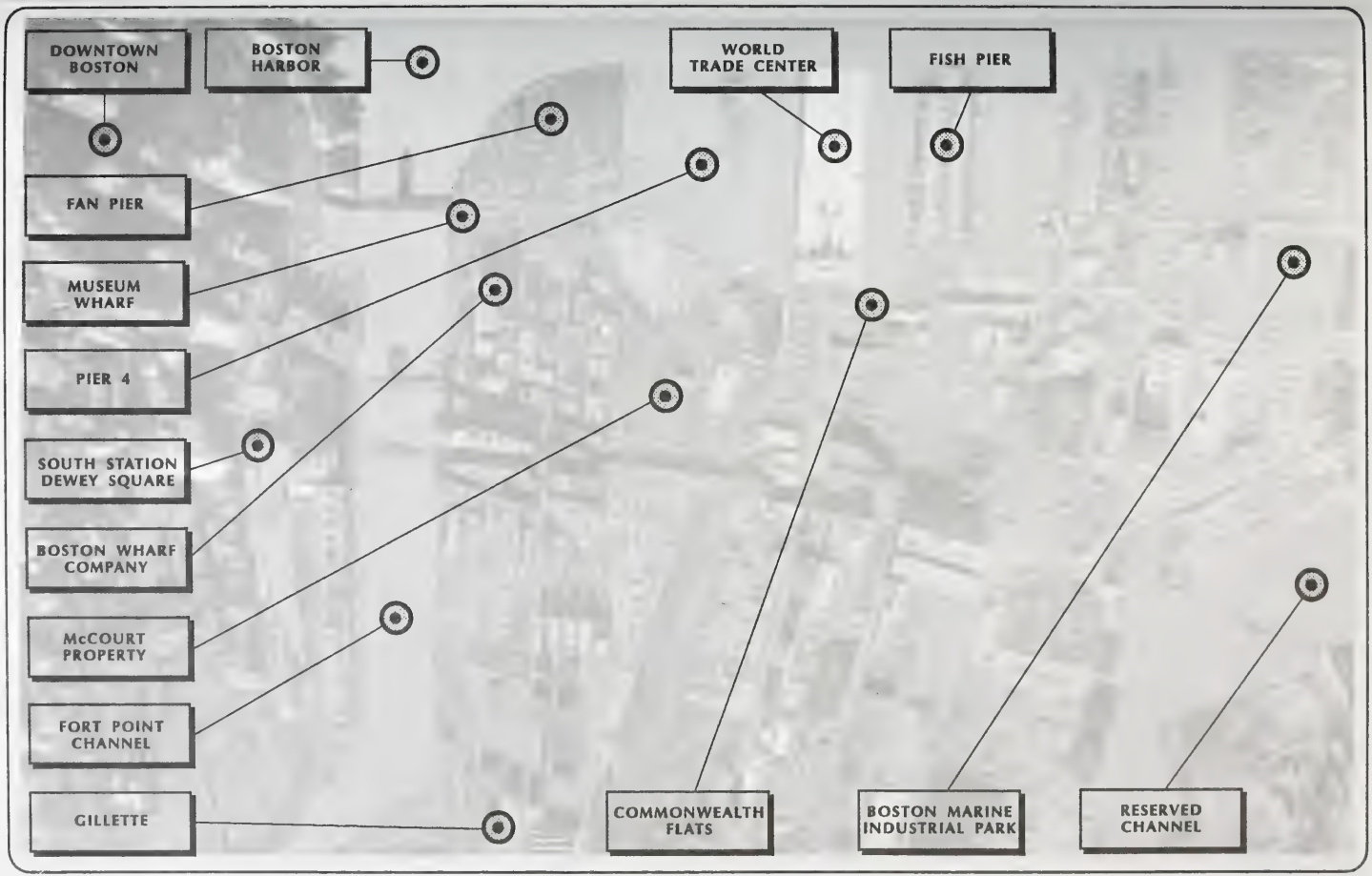
The South Boston Piers/Fort Point Channel area shown in Figure 1-1 is composed of approximately 300 acres of underutilized land located directly east of Boston's central business district (CBD) and one mile south of Logan International Airport across the Boston Harbor. Created by landfill between 1870 and 1920 through a series of joint public/private investments aimed at enhancing the economic strength of Boston and the region, the Piers area in the 1920s boasted one of the busiest waterfronts in the country. Goods such as lumber, coal, leather, cotton, wool, cattle, and molasses were moved to and from the area's piers, wharves, and warehouses via a regional rail network. The Piers area also supported a vibrant manufacturing industry including production of building materials, machinery, soap, sugar, and beer. In 1900, the Piers area employed half of Boston's industrial workers.

After World War II, however, significant changes in transportation and market demands led to the area's decline. The shift from railroads to trucking as the predominant mode of land transportation, the lack of adequate roadway infrastructure in the Piers area, basic changes in intercontinental transportation patterns, and the introduction of containerized shipping technologies all combined to diminish the importance of the industrial, maritime, and railroad activities of the Piers area. Warehouses, piers, and railyards were demolished and replaced with parking lots, and for three decades, the area was largely abandoned. Only when Boston's economy began to rapidly expand in the late 1970s and 1980s was interest in the Piers area rekindled. Urban pioneers such as artists and small museums were attracted to the spacious warehouse space so close to downtown. The City of Boston acquired an abandoned Army base at the far eastern end of the Piers for the purpose of promoting light industrial and maritime uses. Commonwealth Pier was converted into the World Trade Center, a major conference and exhibition facility.

Today, the New England region is seeking to avail itself of trade opportunities with the Pacific Rim, the European Community, and Eastern Europe. The region is now home to several incubator industries such as biotechnology and pharmaceuticals, and continues to be a center for high technology, service industries, and higher education. While these opportunities and industries form the bulwark of the twenty-first century economy, realization of the region's goal to share in this economy is threatened by the inability of Boston's small, crowded, and overburdened downtown core to accommodate continued growth. As a result, planners and developers have turned to long neglected areas on the periphery of downtown.

1.2 NEED FOR TRANSPORTATION IMPROVEMENTS

The unique locational advantages of the Piers area, such as adjacency to downtown Boston and Logan International Airport, deep port capabilities, and full interchange to the interstate highway system and other transportation infrastructure, represent a singular opportunity to leverage and lead new economic growth patterns. According to growth projections developed for the Central Artery (I-93)/Third Harbor Tunnel (I-90) Project, the Piers area, containing 9 million square feet of development today, could accommodate more than 21 million square feet by the year 2010. However, it must be recognized that the Piers area may not be immune to the effects of the recent national and regional economic slowdown. The corresponding slowdown in Boston's employment growth, in particular, has added an element of uncertainty to the magnitude of development forecasts for this area. For these reasons, two development growth scenarios are presented throughout this FEIS/FEIR; these scenarios are described in the following section. Regardless of the total development that will occur by 2010, a shift from land uses, such as industrial activities, that generate relatively low levels of trip demand per square foot of development, to other uses, such as offices and retail establishments, that generate significantly higher demand, is anticipated. Major development projects slated for the Piers area in the next decade include construction of the recently sited



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South Boston Piers/ Fort Point Channel Transit Project

Fig. 1-1
Aerial View of the South Boston Piers/Fort Point Channel Area

Federal Courthouse at Fan Pier, the World Trade Center expansion, Summer Street office conversion, mixed-use development of the McCourt Company properties, and continued growth at the Boston Marine Industrial Park. The area as it appears today is shown in Figure 1-2. Some of the Boston Redevelopment Authority's (BRA) conceptual visions for the area can be seen in Figure 1-3.

Increased development brings increased traffic. Planned roadway improvements described below would greatly improve access to the relatively isolated area. However, regional policy is to accommodate this travel on mass transit. Furthermore, unless transit service to the Piers area is provided, the demand for roadway access could far outstrip capacity. As a consequence, the total amount of new Piers area development could be capped by the occurrence of gridlock conditions and unacceptable environmental conditions, limiting the potential expansion of the city's economic base.

1.2.1 Development Growth Projections

As noted above, one set of growth projections used for the South Boston Piers area was developed for the Massachusetts Highway Department (MHD, formerly the Massachusetts Department of Public Works) for the CA/T Project. These projections represent a comprehensive compilation of data on existing (1986 base) and future land use for downtown Boston and its immediate surroundings. ***They have been used for planning purposes by various state and local agencies, including the MHD, MBTA, and BRA.*** In order to ensure consistency in traffic and transit ridership forecasting, the CA/T Project growth projections are presented in this FEIS/FEIR as one basis for assessing transportation and environmental impacts.[1]

As with any twenty-year forecast, however, some uncertainty about the timing of future development is inevitable. To address this uncertainty, a lower growth development scenario and associated ridership projections for 2010 are presented throughout this FEIS/FEIR. The lower growth scenario is based directly on the CA/T Project development forecasts for 2000 including the underlying zonal and land use parameters. For purposes of differentiation, the 2010 CA/T Project forecasts are referred to as a "high" growth scenario for 2010, while the 2000 forecast is referred to as a "lower" growth scenario for 2010. The lower growth scenario is not necessarily to be viewed as a lowest bound on what may occur. Development forecasts for the two growth scenarios are presented in Table 1-1.

Anticipated development in the Piers area is projected to generate an increase in trip demand from roughly 7,000 peak hour, peak direction trips today to almost 18,000 by 2010 in the high growth scenario and to almost 12,000 in the lower growth scenario. Daily one-way trips are expected to increase from 40,000 today to 90,000 in the high growth scenario and to 68,000 in the lower growth scenario during the same period.

1.3 DEFINITION OF THE PROJECT SERVICE AREA

Figure 1-4 shows the two major areas of Boston — South Boston Piers/Fort Point Channel and downtown — that comprise the project service area. Characteristics of these areas are described briefly below.

1.3.1 South Boston Piers/Fort Point Channel Area

The South Boston Piers/Fort Point Channel area is a 300-acre peninsula bordered by the Fort Point Channel on the west, Fargo and Summer Streets on the south, Boston Harbor on the north, and the Reserved Channel and Boston Marine Industrial Park on the east.

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[1] These projections were also used for the project's state Draft Environmental Impact Report (MBTA, September 1989) which received its Certificate of the Secretary of Environmental Affairs in February 1990, and the Draft Environmental Impact Statement/Supplemental Draft Environmental Impact Report which received its Certificate in January 1993.

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South Boston Piers/ Fort Point Channel Transit Project

Fig. 1-2, 1-3
South Boston Piers

Fig. 1-2
South Boston Piers
as it Appears Today

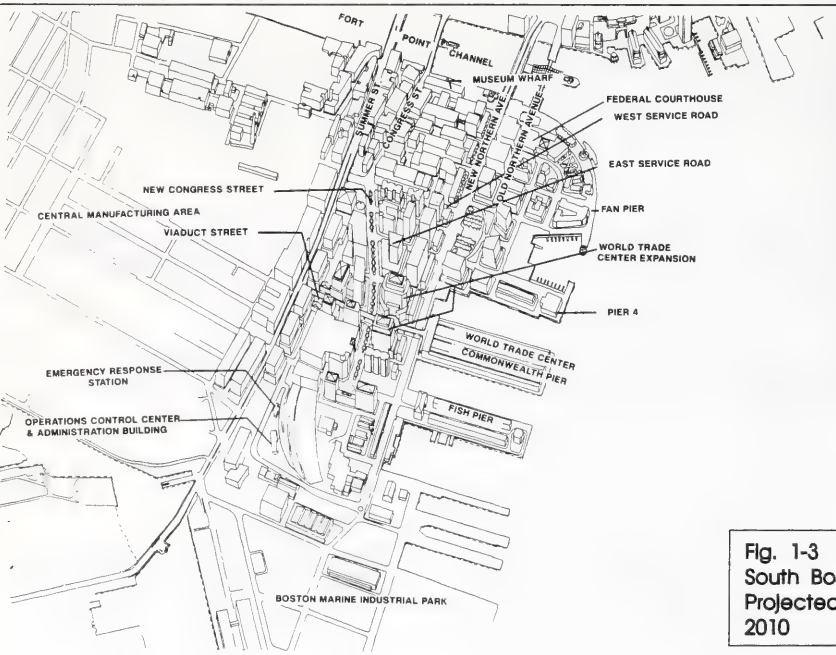

Fig. 1-3
South Boston
Projected Development
2010

TABLE 1-1: SOUTH BOSTON PIERS/FORT POINT CHANNEL AREA CURRENT AND PROJECTED LAND USE (thousands of square feet)

Land Use Category	Base	2010 Lower Growth	2010 High Growth
Office	2,342.8	6,015.0	10,322.5
Retail	290.3	435.8	833.7
Cultural/Recreational	554.9	592.9	663.4
Industrial	5,862.7	6,039.4	6,172.6
Hotel	0.0	229.0	1,445.0
Residential	102.9	770.7	2,064.3
Transportation	182.6	227.6	232.6
Total	9,336.2	14,310.4	21,734.1

Source: Massachusetts Department of Public Works. *Land Use Projections for the Boston Metropolitan Core, 1986-2010*, July 1989.

The Piers area presently houses a variety of uses, including industrial, cultural, retail, and residential. The western edge of the area along Fort Point Channel is dominated by the nineteenth century buildings of the Boston Wharf Company. For some time, these buildings have been undergoing a gradual conversion and rehabilitation from light industrial and warehouse uses to office and residential space. Also in this area is Museum Wharf, home to three popular museums — the Children's Museum, the Computer Museum, and the Boston Tea Party Ship Museum. Bordering the Boston Harbor, Pier 4 has been occupied for three decades by the renowned restaurant of the same name. Numerous other seafood restaurants are scattered along the Northern Avenue corridor, and many wholesale seafood companies are located throughout the area. In recent years, maritime activities at Commonwealth Pier have been replaced by the World Trade Center, a major conference and exhibition facility. The eastern end of the Piers area is dominated by the Boston Marine Industrial Park (BMIP), a former U.S. military reservation now used for the promotion of light industrial and maritime uses. BMIP houses 150 companies including the Boston Design Center, New England's headquarters for the interior design industry.

In general, the western third of the area (Fort Point Channel to B Street including Fan Pier and Pier 4) is owned by private interests; the center area known as Commonwealth Flats (B Street to the western edge of BMIP including the Commonwealth and Fish Piers) is owned by the Massachusetts Port Authority; and the eastern end (BMIP) is owned by the City of Boston's Economic Development and Industrial Corporation. The area currently contains approximately 9 million square feet of developed land, most of which is used for industrial or maritime purposes. However, much of the remaining area west of BMIP is either vacant or occupied by surface parking lots which, in the western third of the area, provide a source of relatively inexpensive peripheral parking for the CBD.

1.3.2 Downtown Boston

For purposes of this study, downtown Boston is an amalgam of several distinct BRA planning districts — the Midtown District, Chinatown, the Leather District, and the South Station area. Total current development in these areas is approximately 12 million square feet. Downtown areas are briefly characterized as follows:

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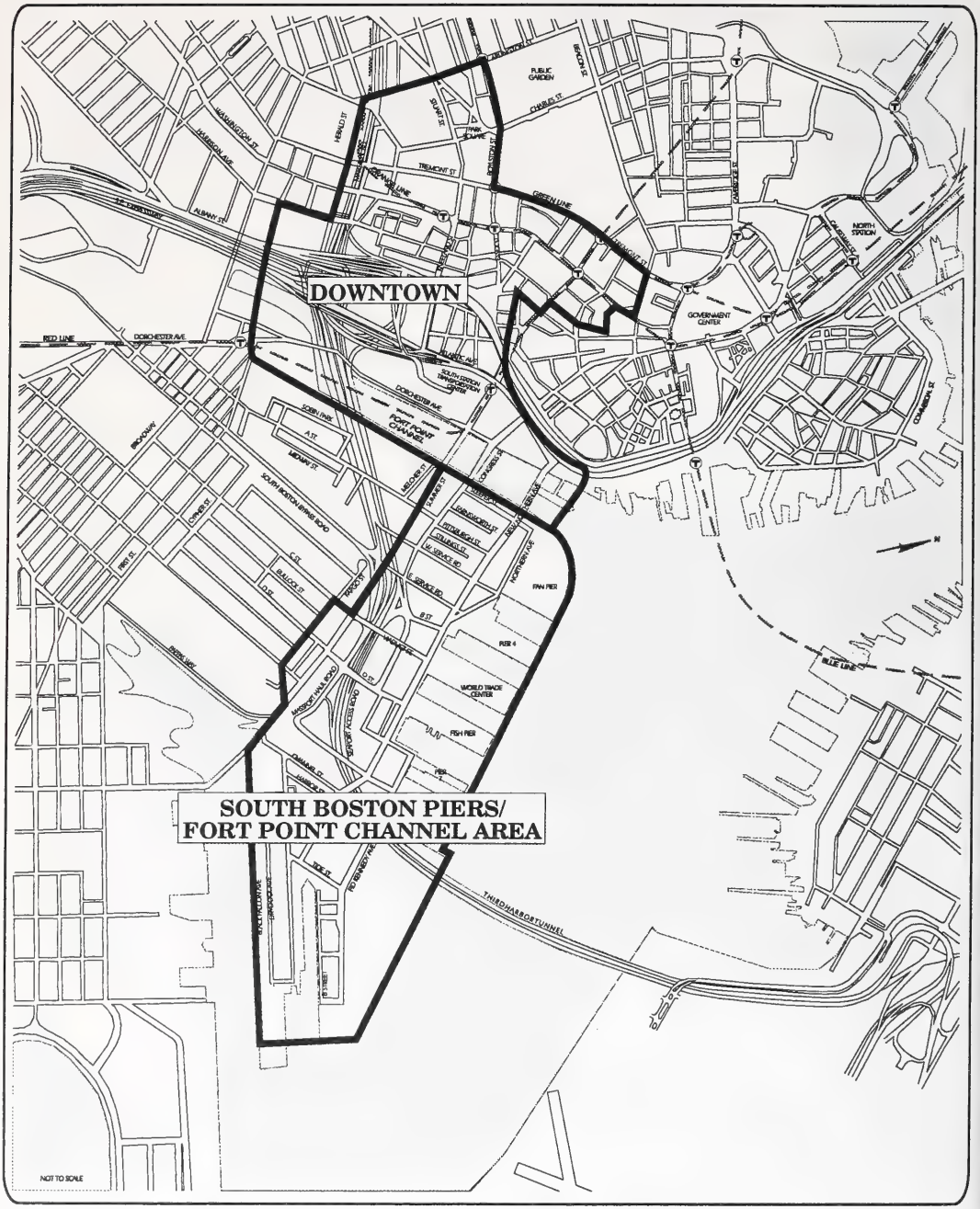
South Boston Piers/ Fort Point Channel Transit Project

Fig. 1-4
Project Service Area



- **Midtown District** - This district is composed of two distinct areas — Downtown Crossing and Park Square/Theatre District. The Downtown Crossing area, Boston's major retail district, is generally bordered by City Hall Square to the north, Essex Street to the south, the Financial District to the east, and Tremont Street to the west. The Park Square/Theatre District area has historically housed the music and theater industries. The area is generally bordered by the Boston Common/Boston Public Gardens to the north, the Massachusetts Turnpike to the south, Chinatown to the east, and Boston's Back Bay and South End to the west.

- **Chinatown** - Chinatown is a mixed-use neighborhood that is home to the city's growing Asian population; it is generally bounded by Essex Street to the north, the Massachusetts Turnpike to the south, the Surface Artery to the east, and Tremont and Washington Streets to the west. The area supports a variety of land uses including commercial, retail, institutional, manufacturing, and residential. Major employers in the area include Tufts New England Medical Center, local restaurants and shops, and manufacturing firms associated primarily with apparel/textile production and scientific-related industries, such as electronics. Also located within the boundaries of Chinatown is a portion of the Combat Zone, an adult entertainment district whose businesses are generally situated along Washington Street, north of Kneeland Street.

- **Leather District** - The Leather District is a nine-block area located adjacent to the eastern boundary of Chinatown and bounded by Kneeland Street to the south, Essex Street to the north, Atlantic Avenue to the east, and the Surface Artery to the west. The Leather District has historically supported leather and manufacturing industries. It is only recently that the composition of the area has expanded to include office, commercial, and limited residential uses.

- **South Station Area** - For the purposes of this study, the South Station area includes a portion of the Financial District bordered by Northern Avenue to the north, the Fort Point Channel to the east, and the Central Artery to the west, in addition to South Station and Dewey Square. The area is dominated by public facilities and new mid- to high-rise office buildings, most of which house large firms associated with financial services. No residential community occupies the area. At the center of the area is the South Station Transportation Center. Other public facilities in the South Station area include the South Boston Postal Annex, the city's central mail distribution facility located adjacent to South Station. Also located in the area are the Trailways/Peter Pan bus terminal and MBTA subway car storage. The Federal Reserve Bank is situated on the block bounded by Atlantic Avenue, Dorchester Avenue, and Summer and Congress Streets.

1.4 TRANSPORTATION FACILITIES AND SERVICES IN THE PROJECT SERVICE AREA

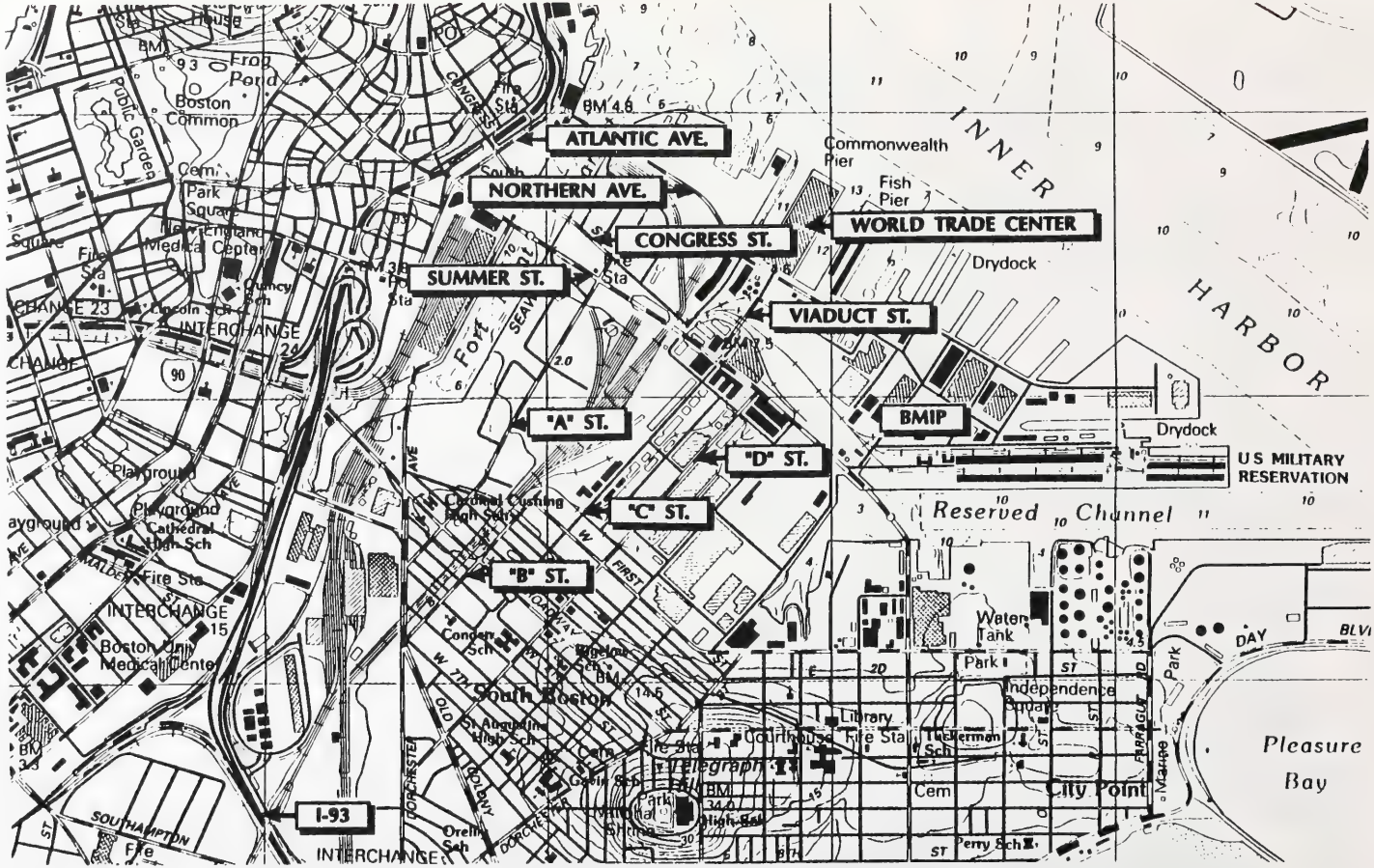
1.4.1 South Boston Piers/Fort Point Channel Area

Despite its location near the crossroads of the regional transportation network, the Piers area currently suffers from limited accessibility. Three local bridges serve most automobile and pedestrian traffic, while three local bus routes provide the only transit service. Current and future characteristics of transportation facilities and services in the Piers area are described below.

1.4.1.1 Highway Access and Street Network

Current Characteristics

As shown in Figure 1-5, the South Boston Piers area is served by two east-west arterials — Northern Avenue in the north of the area and Summer Street in the south — that begin in the CBD and traverse the area to its eastern edge at BMIP. Both arterials enter the area via bridges across the Fort Point Channel,



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 1-5
South Boston Piers/Fort Point Channel Area Existing Street Network

as does Congress Street which terminates roughly in the middle of the area. Summer Street is on a viaduct through part of the area, providing a connection by means of Viaduct Street to the upper level of the World Trade Center. Local roadways such as A, C, and D Streets provide access from the south.

The Piers area is located a short distance from the center of the regional highway network. The Central Artery (I-93) serves as the focal point for major radial routes such as the Massachusetts Turnpike (I-90), the Southeast Expressway (I-93/SR 3), Interstate 93-North, the Northeast Expressway/Tobin Bridge (US 1), and the McLellan Highway/Sumner-Callahan Tunnels (SR 1A). As the major north-south access route through downtown Boston, the Central Artery is also a primary route to the Piers area from most corridors. The Central Artery handles the highest traffic volumes in the downtown area; at over 175,000 vehicles per day, volume exceeds design capacity by 100 percent. As a consequence, congestion plagues the Central Artery at most times of the day and is especially severe during peak periods. Ramps from the Central Artery provide access to the Piers area via local roadways and several bridge crossings of the Fort Point Channel.

Significant local traffic congestion, particularly during the peak periods, occurs throughout downtown Boston and on the three major arterials providing access between the Piers area and downtown: Northern Avenue, Congress Street, and Summer Street. These arterials intersect with Atlantic Avenue on the CBD side of the Fort Point Channel. While Atlantic Avenue serves as a major connector between Central Artery ramps and the local street network feeding into the Piers area, operating conditions along Atlantic Avenue limit traffic flow between the downtown and the Piers area. Significant congestion occurs at the intersection of Atlantic Avenue and each of the three main arterials that connect to the Piers area. Intersections with Atlantic Avenue at Northern Avenue, Congress Street, and Summer Street function at level of service (LOS)[2] E or F on certain approaches in the peak hour.

In the Piers area, substantial traffic congestion currently occurs during the peak hour at numerous locations, particularly along Congress Street and Northern Avenue. According to analysis conducted for the CA/T Project, the majority of intersections on those streets have been determined to be operating at an unacceptable LOS (e.g. LOS E or worse). For example, the intersections of Congress Street and A Street and Northern Avenue and Sleeper Street were found to be operating at an unacceptable LOS in both the a.m. and p.m. peak hours, while the intersection of Northern Avenue and Sleeper Street operates at LOS F in the p.m. peak. Constraints at the Northern Avenue/Sleeper Street intersection, combined with operating conditions at the Congress Street/Dorchester Avenue and Congress Street/Atlantic Avenue intersections, hinder traffic movement between downtown and the Piers area.

Anticipated Changes

Three major roadway projects would greatly enhance the accessibility of the Piers area:

1) **Construction of a New Northern Avenue Bridge**. The new bridge to be constructed by the MHD would accommodate traffic currently served by the existing Northern Avenue bridge. Due to the existing bridge's low expanse, it must be opened to let ships pass. Traffic is disrupted both at these times and during periods of bridge repair work. The new bridge would extend high enough over the channel to permit boats to pass beneath and would provide a more welcoming entrance to the Piers area than its dilapidated counterpart. The new bridge substructure is in place, and construction of the superstructure and approaches is underway.

2) **MHD's Central Artery (I-93)/Third Harbor Tunnel (I-90) Project**. The CA/T Project will complete the interstate highway system in Boston. It will replace the existing six-lane

[2] LOS is a standard measure of traffic operating conditions at intersections as well as on highways and ramps. LOS criteria indicate the overall operating conditions confronting the motorist, and incorporate traffic stream densities, flow interruptions, and travel speed, among other factors. Measures of LOS range from A (free-flowing traffic) to F (significant congestion and delays). LOS is described more fully in Chapter 4.

elevated section of the I-93 Central Artery with a new eight to ten-lane road, mostly underground, between the Southeast Expressway and Charlestown. It will also extend the I-90 Massachusetts Turnpike to Logan Airport via a Seaport Access Road passing through the South Boston Piers area and a four-lane tunnel under Boston Harbor. To minimize construction impacts, the South Boston Bypass Road will serve construction and other truck traffic generated by the project.

Roadway links provided by the CA/T Project would transform the relatively isolated Piers area into a well-connected one. The Seaport Access Road, which includes a major interchange in the Piers area, would enable vehicles to travel to the Piers area via an interstate highway instead of city arterials and small bridges. The Third Harbor Tunnel would provide a direct highway link to Logan Airport and Boston's North Shore. In addition, the South Boston Bypass Road would provide commercial and high occupancy vehicles (HOVs) with an exclusive right-of-way from the Southeast Expressway/Massachusetts Avenue interchange to the Piers area. The new Central Artery would both increase roadway capacity and improve access to the north and south. A consequence of its depression would be the removal of the Artery elevated structure which has long divided the Piers area from the CBD.

3) **Creation of a new local street network**. A new local street network for the Piers area has been developed by the Boston Transportation Department in coordination with the design of the Seaport Access Road and the BRA's development and open space planning for the area. The goal of the network design is to provide good access for traffic entering the area from the Seaport Access Road or downtown, while preventing downtown commuter traffic from passing through the area and the adjacent South Boston residential neighborhood. The proposed local street network would conform to three development corridors trisecting the Piers area from west to east. Along the northern edge, New Northern Avenue would be constructed just south of existing Northern Avenue, extending from the New Northern Avenue bridge to Pier 4. South of this corridor, New Congress Street would be constructed at the termination of existing Congress Street, extending northeastward across Commonwealth Flats to D Street. The Summer Street corridor defines the southern perimeter of the Piers area.

1.4.1.2 Transit Access

Current Characteristics

Current transit access to the South Boston Piers area is extremely limited. Only three local MBTA bus routes currently operate to and through the Piers area. This bus service is characterized by low frequency of operation, indirect routings, and low capacity. Moreover, although the Piers area is adjacent to Boston's CBD, it does not receive the benefit of well developed regional mass transit services provided throughout the CBD. In order to access the Piers area from the Orange Line, the Green Line, or North Side Commuter Rail, a minimum of two transfers is currently required. For example, a 1.8-mile transit trip from Boston's South End to the Fan Pier currently takes almost 35 minutes[3]. Roughly two-thirds of this time is spent out-of-vehicle, generally either waiting for transit vehicles or walking. Likewise, a transit trip from Malden, located only 6 miles from the World Trade Center, takes an hour with more than half of this time spent waiting or walking. A transit trip from Watertown, 8 miles from the World Trade Center, takes over an hour. Again, waiting and walking account for well over half of this travel time from Watertown.

Although South Station (a major focal point for regional transit services, including buses, Red Line rapid transit, and commuter rail) is located directly across the Fort Point Channel from the Piers area, much of the development planned in the Piers area is not within walking distance of South Station. Based on current estimates of walk distance and behavior in Boston, only the developments along the southwestern

[3] Unweighted travel time.

portion of the Piers area, such as Museum Wharf and the Boston Wharf Company, are readily accessible on foot. This is a distance of approximately 0.4 miles. ***The new Federal Courthouse*** at Fan Pier is at least 0.6 miles from South Station. The World Trade Center and BMIP are far beyond the typical walk distance from South Station as shown in Figure 1-6.

Anticipated Changes

By 2010, the MBTA plans to implement numerous expansion projects including those described below. The present status of these projects is discussed in Chapter 3, Section 3.3.5.1.

- **Old Colony Railroad Restoration** - The MBTA is restoring commuter rail service on two branches (Middleborough and Plymouth) of the Old Colony Railroad which serviced southeastern Massachusetts until 1959. Direct service into South Station is planned by late 1996. Service restoration on a third branch (Greenbush) is undergoing environmental review.

- **Newburyport Commuter Rail Extension** - Current commuter rail service between North Station and Ipswich will be extended to Newburyport. Two new stations — one in Rowley and the other in Newburyport — would be constructed with parking provided at both.

- **Other Commuter Rail Extensions** - The MBTA is studying three other commuter rail extensions assumed to be in place by the year 2000. The Worcester extension of the Framingham Line is expected to involve construction of four new stations. Extension of the Franklin Line to Milford and of the Stoughton Line to East Taunton will provide additional commuter rail service to the south. Service provided by these extensions would operate through South Station.

- **Washington Street Replacement Transit Service** - With the relocation of the Orange Line to the Southwest Corridor and demolition of the elevated Orange Line tracks along Washington Street, the MBTA has proposed to replace transit service between Dudley Square and downtown Boston. Initial service provided by the Replacement Transit Improvement Project (RTIP) would likely consist of an entirely surface bus operation terminating in the vicinity of Avenue de Lafayette and Washington Street. In a later phase of the project, the existing Tremont Street portal at Pleasant Street in the vicinity of New England Medical Center would be reactivated and a tunnel connection built to Boylston Station.

- **South Station Transportation Center** - A new consolidated bus terminal and parking structure will be constructed above the commuter rail tracks and platforms, converting South Station into an intermodal transportation center. The project will combine intercity and commuter railroad operations, intercity and suburban bus operations, rapid transit, a connection to Logan Airport, and parking facilities.

- **North Station Transportation Improvement Project** - In coordination with plans to develop a new sports arena at the site of the existing Boston Garden, North Station will be redesigned as a multi-modal Transportation Center incorporating commuter rail and rapid transit service. Construction of new handicapped-accessible high platforms and an underground parking garage is currently underway.

- **Parking Expansion** - A park-and-ride program has been implemented which will increase parking at rapid transit and commuter rail stations throughout the system. By the year 2000, an additional 10,000 spaces will be constructed inside the MBTA district, and another 10,000 spaces will be constructed outside the district. Up to 20,000 additional spaces are planned at stations throughout the system by 2010.

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South Boston Piers/ Fort Point Channel Transit Project

Fig. 1-6
Piers Area within .4 Mile Walking Distance of South Station

The South Boston Piers/Fort Point Channel Transit Project has been undertaken to identify and evaluate alternatives that can attract a high percentage of transit ridership from the estimated 11,000 (high growth) to 5,000 (lower growth) new peak hour/peak direction trips to the Piers area that would be generated by anticipated development. Additional transit services would need to be provided to link the Piers area with downtown transfer points as well as suburban areas and urban neighborhoods. This study addresses those needs.

1.4.1.3 Parking

Current Characteristics

With its current inventory of 8,615 parking spaces, the Piers area serves as a source of relatively inexpensive peripheral parking for downtown Boston. Surface parking lots are concentrated in the western third of the Piers area which is generally within walking distance of South Station and the Financial District.

Anticipated Changes

As part of the State Implementation Plan required by the Clean Air Act, the Metropolitan Planning Organization has instituted a parking freeze in the South Boston area. The three zones covered by the freeze are shown in Figure 1-7 and include the Piers area in addition to industrial and residential South Boston. Key provisions of this freeze are as follows:

- The number of off-street parking spaces in the three zones will be frozen at the existing level.
- From this base inventory, a parking space bank consisting of an additional 10 percent will be created.
- At the full opening of the Central Artery/Third Harbor Tunnel, a new inventory of parking will be made in the South Boston Piers zone only.
- Following the new inventory, an additional allocation of spaces will be made to the South Boston Piers zone, equalling an additional 10 percent of the total number of parking spaces in the inventory and freeze bank.

A primary objective of the South Boston Parking Freeze is to encourage transit as the preferred transportation mode for all new development in the South Boston Piers area.

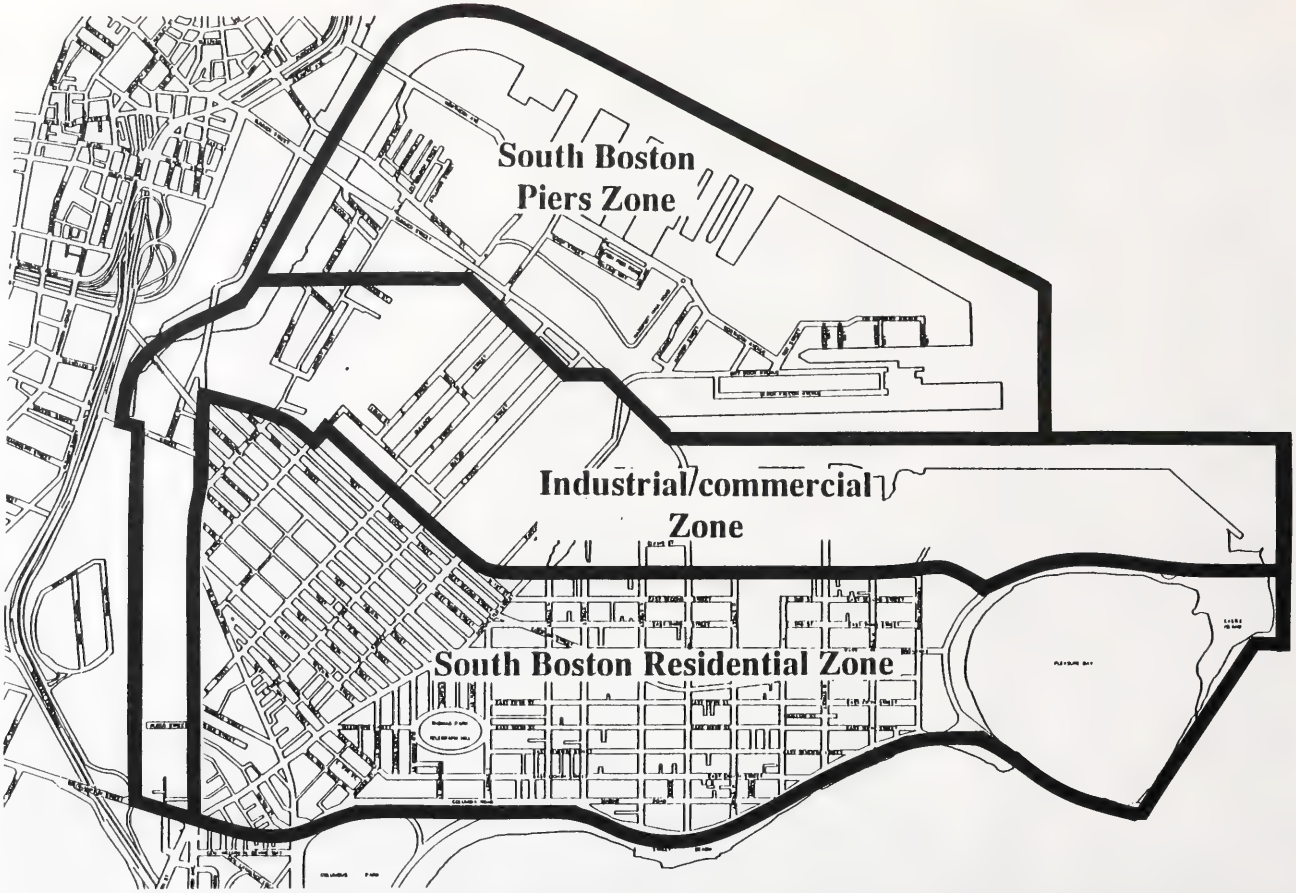
1.4.2 Downtown Boston

Traffic conditions in downtown Boston have historically been characterized by congestion and long delays due to an irregular street pattern poorly suited for vehicular travel. However, the area is well served by public transportation which alleviates demand on its congested streets. Current and future characteristics of transportation facilities and services in downtown Boston are described below.

1.4.2.1 Highway Access and Street Network

Current Characteristics

Access to downtown Boston is provided by major highways from the north, south, and west. The Mystic-Tobin Bridge (U.S. Route 1) and the Sumner/Callahan Tunnels (State Route 1A) serve communities north and northeast of Boston. Both the bridge and the tunnels connect with north-south Interstate Route 93 which includes the Central Artery and Southeast Expressway to the south. As noted above in Section



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South Boston Piers/ Fort Point Channel Transit Project

Fig. 1-7
South Boston Parking Freeze Zones

1.4.1.1 (Current Characteristics), the Central Artery handles the highest traffic volumes in downtown Boston,with volumes twice as high as design capacity. Interstate Route 90 (Massachusetts Turnpike) and Storrow Drive provide major east-west connections between the Central Artery and communities to the west.

South Station Area

Three east-west arterials traverse the South Station area: Summer Street, Congress Street, and Northern Avenue. These arterials cross the Fort Point Channel via bridges to the South Boston Piers area. Atlantic Avenue provides north-south service through the South Station area, intersecting with all three east-west arterials.As described above in the current street network characteristics of the Piers area (see Section 1.4.1.1), significant traffic congestion occurs along Atlantic Avenue at its intersections with Summer Street (Dewey Square), Congress Street, and Northern Avenue. These intersections operate at LOS E or F in the peak hours, severely constricting the flow of traffic along Atlantic Avenue and access to the Piers area.

Chinatown/Leather District

The Chinatown/Leather District is intersected by several major arteries providing crosstown access and connections to the regional highway system. These streets include Essex Street, the Surface Artery, Kneeland Street, and Tremont Street. Traffic congestion varies throughout the district, with the highest levels occurring in the commercial area north of Kneeland Street. This is due in part to roadway capacity constraints, generated by double parking, and to vehicular and pedestrian conflicts. These problems are most prevalent during the p.m. peak hour, but also occur on Saturdays with Asian visitors and shoppers. The congestion often contributes to gridlock conditions in and around the commercial area. A result of this congestion is trip diversion through the commercial core, on streets such as Beach Street and Harrison Avenue. Congestion in the southern section is less pronounced due to the predominant residential and institution related activities. However, an inadequate street orientation system and poorly located institutional parking result in a large amount of vehicular traffic circulating on neighborhood streets in the densely populated residential area.

Midtown District

Although the Midtown District is easily accessed by car from Storrow Drive, the Massachusetts Turnpike, the Central Artery, and the Southeast Expressway, this access is not matched by an easily used network of arterial streets within the Midtown area. The district's major east-west arteries are Stuart/Kneeland and Boylston/Essex Streets. However, Essex Street is one-way, allowing only east-bound travel. Charles Street is the major northbound artery, while Chauncy and Washington Streets carry some northbound traffic. Washington Street's northbound arterial role is restricted by the presence of the Downtown Crossing pedestrian mall. Tremont Street is the major southbound artery, while Bedford Street, Chauncy Street, one block of Washington Street, and Avenue de Lafayette also provide some westbound and southbound service.

Four of the district's five worst intersections are located on the Boylston/Essex corridor: at Charles Street, Tremont Street, Washington Street, and Chauncy Street/Harrison Avenue (Philips Square) which currently operates at LOS F in the p.m. peak hour. The fifth problem intersection is at Stuart and Tremont Streets, where east-west traffic merges with southwest-bound traffic. Traffic problems in the district are worsened by a confusing network of one-way streets, loading zones, parking lanes, and turning lanes.

Anticipated Changes

The CA/T Project described above in Section 1.4.1.1 would have the most profound impact on the movement of traffic through and within downtown Boston. Many improvements proposed by the project would affect the Central Artery and the numerous other regional highway facilities to which it connects. These facilities serve through traffic; traffic to downtown; traffic traveling within the downtown on surface streets; traffic to and from East Boston, Logan Airport, and the North Shore; and traffic destined for the developing Piers area.

In concert with the benefits afforded by the CA/T Project, the Boston Transportation Department (BTD) will undertake minor adjustments to downtown streets intended to improve traffic circulation in the city core. Potential improvements include prohibiting turns onto Chinatown's Beach Street from the Surface Artery; restricting a section of Columbus Avenue in Park Square to local traffic and shifting through traffic to St. James Street; and allowing two-way traffic on Essex Street between Avenue de Lafayette and Atlantic Avenue. BTD is currently developing a Downtown Transportation Master Plan, identifying short and long-range strategies to improve transportation in downtown Boston.

1.4.2.2 Transit Access

Current Characteristics

Downtown Boston is currently well served by transit. Transit services provided in each affected planning district in downtown Boston are described below.

South Station Area

At the center of this area is South Station. The MBTA is in the process of completing a major renovation of this station which will convert it into a true multi-modal Transportation Center and office complex. The recently renovated station includes a direct connection to the Red Line, enhanced commuter rail track and platform space, and restoration and remodelling of the historic headhouse. South Station supports Red Line heavy rail transit service in addition to commuter and intercity rail and bus services. The Trailways/Peter Pan bus terminal is also located in this area.

Chinatown/Leather District

There are several public transportation options available to residents of Chinatown. Residents can walk to three subway stations including Boylston Station, a Green Line stop, the New England Medical Center Station, and the Chinatown Station; the latter two stations are both Orange Line stops that connect with the Red, Green, and Blue Lines. In addition, a local bus (Route 3) runs between Chinatown and BMIP. The neighborhood is also served by buses that connect Chinatown with outlying suburbs. Free shuttle bus service to medical and recreational destinations is available to elderly residents of Chinatown and other Boston neighborhoods.

Midtown District

Three of the MBTA's four subway lines have stations in the Midtown District. The Green Line has stations at Park Street, Boylston, and Arlington, the Orange Line serves Downtown Crossing, and the Red Line stops at the Park Street and Downtown Crossing Stations. Significant MBTA and private carrier bus service is also provided in the Midtown District with several routes originating and terminating in the Park Square area.

Anticipated Changes

Expansion projects that are scheduled to be implemented by the MBTA include several commuter rail extensions, replacement transit service between Dudley Square and downtown Boston, and station improvements including a second phase of work at South Station which will provide a new commuter and intercity bus terminal situated over the station's tracks and platforms with a direct ramp connection to the Central Artery/Third Harbor Tunnel. Relevant projects were described previously in Section 1.4.1.2.

1.4.2.3 Parking

Current Characteristics

In accordance with the provisions of the Clean Air Act, the City of Boston adopted on July 16, 1976, a parking freeze within Boston Proper; downtown is included within the boundaries of Boston Proper, which

is defined by the Atlantic Avenue waterfront on the east, by the Charles River and Memorial Drive on the north, by Massachusetts Avenue on the west, and by the Massachusetts Turnpike Extension on the south. The parking freeze is consistent with policies of the city and state established since 1972 to discourage automobile use in downtown Boston, to reduce vehicle miles of travel in the region, and to encourage and develop greater use of public transit. The parking freeze is also consistent with planning objectives to utilize prime real estate for office, commercial, residential, and cultural uses which vitalize the downtown, rather than filling this area with parked automobiles.

The freeze requires that new commercial parking be accompanied by the elimination of spaces at least equal to the number of new spaces being created; the number of parking spaces in the Boston Proper area was frozen at 35,503 as of October 15, 1973. Any modification or closing of a commercial parking facility which reduces the number of commercial parking spaces will be added to a bank which is administered by the Boston Air Pollution Control Commission. Available spaces are allocated using criteria established under the freeze. Currently, approximately 600 spaces are available in the bank.

Anticipated Changes

No changes to the existing parking freeze in Boston Proper are anticipated.

1.5 SPECIFIC TRANSPORTATION PROBLEMS IN THE SOUTH BOSTON PIERS AREA

Traffic analysis has indicated that, unless public transit services capture a high mode share, the already high levels of traffic congestion in portions of the Piers area would be exacerbated by trip demand generated by new development. Bridge links to downtown via New Northern Avenue, Congress Street, and Summer Street would be especially congested if no new transit service is provided, since these bridges are the only direct access points from South Station and downtown to the Piers area.

The interfaces between Piers area roadways and the CBD currently produce some of the worst traffic congestion in the city. At present, the intersections of Atlantic Avenue with Northern Avenue and Congress Street both operate at LOS F in the p.m. peak hour, while the Atlantic Avenue/Summer Street intersection operates at LOS E. Approach delays at these three intersections exceed 60 seconds and cause traffic to back up on the arterials into the Piers area. When the additional trip demand that would be generated by proposed Piers area development in the high growth scenario is added to the local street network, severe traffic congestion (LOS F) occurs at a number of key intersections including Summer Street/D Street, Massport Haul Road/D Street, and Congress Street/East Service Road where the delay totals 3 minutes. Thus, the additional roadway capacity afforded by such projects as the New Northern Avenue and bridge and the new Piers area street network would be consumed by the trip demand of projected high growth development resulting in traffic congestion and associated negative environmental impacts. In the lower growth scenario, none of the Piers area intersections would experience levels of service worse than D.

This study was undertaken with the expectation that the provision of high capacity, high quality transit service would divert a large percentage of trips from the street and highway network. It was further expected that a transit link between major regional rapid transit and commuter rail lines would help ensure that development goals can be achieved in an environmentally sound manner. The success of the alternatives in meeting these expectations is discussed in Chapters 4, 5, and 6 of this FEIS/FEIR.

1.6 PROJECT GOALS

The South Boston Piers/Fort Point Channel Transit Project is part of a comprehensive effort to achieve a series of broad transportation and regional development goals, as well as specific objectives for improving the quality of transportation services throughout the project service area. The establishment of these goals and objectives and the development of the transportation plan and program to accomplish them has been supported by an ongoing policy-making and planning process.

A number of important studies, reports, and policy statements have helped to document the development of transportation policy in eastern Massachusetts. Among these are the following:

- In 1966, as required by law, the MBTA developed and the Advisory Board approved a comprehensive *Program for Mass Transportation* (PMT).

- The *Boston Transportation Planning Review* (BTPR) (1970-73) reexamined the highway construction program in the Boston area and established a new transportation strategy which emphasized transit as a means to provide additional transportation capacity.

- *Toward a New Growth Policy for Massachusetts* (1977), a state cabinet-level document, stated the need to maintain downtown Boston as a strong and healthy economic and employment core for the eastern Massachusetts region, and encouraged redevelopment of the older urban areas across the state.

- The revised PMT (1978) was a comprehensive reevaluation of the long-range transit program for the MBTA region, examining its goals, effectiveness, and financing. An update of the PMT was initiated in the fall of 1991, beginning with a comprehensive compilation of potential new transit projects proposed for implementation over a twenty-year planning horizon. This will be followed by screening and analysis of all identified projects and preparation of a short list of projects for inclusion in the PMT. Update of the PMT is projected to be completed in 1994.

- The *Transportation Improvement Program* (TIP) is prepared under the direction of the Metropolitan Planning Organization for the Boston metropolitan area, and reflects the current status of the transportation program for the project area. Updated annually, the TIP is a short-range planning document that describes all transit projects for which federal funding is being requested. The TIP includes projects that are scheduled to be implemented in the next fiscal year as well as a five-year capital program.

- The BRA's *Fort Point District Plan* (1990) identified transportation improvements, including a new roadway network, new interstate highway connections, improvement of existing truck routes, and a mass transit system, as the key to unlocking the Piers area's economic potential.

- The Department of Environmental Protection's proposed *State Implementation Plan* (SIP) Amendment (1991) includes transit improvements that are designed to reduce the use of low-occupancy automobiles in the metropolitan Boston region and improve vehicular traffic operations on the region's highways, resulting in improved air quality. These improvements include the South Boston Piers Transit Project.

Basic elements of the regional economic growth and transportation strategies described by these studies include the following:

- **Maintain downtown Boston as a strong economic hub for the project area**. For the metropolitan area to remain economically sound and prosperous, its downtown core must retain a central identity and focus. The key financial, legal, medical, and cultural services and facilities provided downtown must be allowed to grow and serve a growing metropolitan area. To accommodate and encourage growth in office space, hotel and convention capacity, and other services downtown, it is necessary to provide increased transportation capacity into and out of the city for the use of residents, employees, and visitors. Since little land is available for expanded highways or to park additional cars, this additional capacity must be provided through improvements in transit facilities in central Boston.

- **Encourage transit-oriented development patterns**. In general, the impacts of automobile dependency can be severe. New highways and parking facilities consume vast amounts of land, automobiles contribute to reduced air quality and other undesirable environmental effects, and the urban sprawl encouraged by automobile travel patterns places increased strain on basic public services such as utilities and police and fire protection.

Using these regional development and transportation objectives as a basis, the MBTA has established the following goals for the South Boston Piers/Fort Point Channel Transit Project. These goals were developed through an extensive inter-agency and community participation process and provide a basis for evaluating alternative improvements to transportation services and facilities in the South Boston Piers area.

- Improve transit service to the Piers area
- Enable future economic expansion of the Piers area
- Mitigate potential traffic problems in the Piers area generated by projected development
- Minimize degradation of the natural environment
- Preserve cohesion of existing neighborhoods and communities
- Provide adaptable and reliable transit service
- Provide efficient and productive transit service

1.7 NEXT STEPS

The FEIS/FEIR will be publicly circulated to federal, state, and local agencies, advocacy and business organizations, and private citizens for review and comment. It will also be made available at several local libraries for public review. A distribution list is provided in Appendix B. Comments on this document may be submitted to the Executive Office of Environmental Affairs, and to the MBTA and FTA at the addresses shown at the front of this FEIS/FEIR.

The State of Massachusetts environmental process will culminate, after review and acceptance of this FEIS/FEIR, in the issuance of a written statement by the Secretary of the Executive Office of Environmental Affairs that the FEIS/FEIR adequately and properly complies with the provisions of the Massachusetts Environmental Policy Act and its associated regulations. The federal environmental review process will culminate in a Record of Decision issued by the Federal Transit Administration.

CHAPTER TWO
Alternatives Considered

CHAPTER 2: ALTERNATIVES CONSIDERED

2.1 INTRODUCTION

Planning for the South Boston Piers/Fort Point Channel Transit Project has been underway since 1987 when the Massachusetts Bay Transportation Authority (MBTA), the primary provider of public transportation in the Boston metropolitan region, undertook a feasibility study to identify and evaluate options for enhancing transit service to the Piers area. From the completion of that study in June 1987 to publication of this FEIS/FEIR, numerous alternative solutions to transportation problems in the Piers area have been identified.

This chapter overviews the evolution of project alternatives and describes in detail the alternatives that emerged from the screening process. ***It also identifies the locally preferred alternative that has been selected for implementation.***

2.2 SELECTION AND SCREENING OF ALTERNATIVES

The selection and screening of alternatives for the transit project has been ongoing since 1987. In the sections below, the progression of alternatives development is described.

2.2.1 Inputs from Feasibility Study

In the summer of 1987, the MBTA initiated a feasibility study[1] to provide a preliminary evaluation of new public transit service alternatives to meet the travel demands of future development in the South Boston Piers area. Ideas on potential additional transit services were solicited from a wide range of local agencies and consultants, including the Massachusetts Highway Department (formerly Massachusetts Department of Public Works), Boston Redevelopment Authority, Massachusetts Port Authority, Boston Department of Transportation, and other interested parties. In addition, the study developed modifications of transit proposals that had been advanced by private developers. The parties involved reached a consensus that any new service must emphasize connections to current MBTA rail lines, providing service for as many regional corridors as possible with minimum transfers. Like the rest of the South Boston Piers development, the system must tie into the fabric of downtown Boston.

Based on agency suggestions and analysis by the study team, alternatives were categorized by distinct linkages from the study area to existing or projected transit resources. The possibilities included various transit options:

- Possible Transit Technologies: Conventional Bus, Guided Bus, People Mover, Heavy Rail
- Possible Destinations and Connections for New Service: South Station, Boylston Station, Chinatown Station, Aquarium Station, North Station, Haymarket Station, Copley Station, Back Bay Station, Downtown Crossing, Park Street Station, Broadway Station
- Possible Alignments: At-Grade, Elevated, Below Ground

[1] Massachusetts Bay Transportation Authority. *South Boston Piers/Fort Point Channel Area Transit Feasibility Study.* Prepared by URS Corporation. June 1987.

Approximately 250 logical combinations of technologies, destinations, and vertical alignments could be formed from these options. This number of combinations had to be reduced substantially before any detailed analysis could proceed.

Two criteria, market share and physical feasibility, were critical in the preliminary screening process. Any alternative not believed to be capable of attracting a large transit mode share was dropped from consideration. Other alternatives were dropped because no feasible alignment could be found in the course of a preliminary right-of-way analysis.

At the conclusion of this preliminary screening process, the following six alternatives were selected for detailed analysis in the feasibility study:

1. **Conventional Surface Bus**: Articulated shuttle bus service to the Piers area operated on surface streets to Government Center and via the Seaport Access Road to South Station.

2. **Elevated People Mover to South Station**: A two-track, three-station automated guideway transit (AGT) system operated between South Station and the World Trade Center.

3. **Elevated People Mover to North Station**: A two-track, six-station AGT system over the planned reconstructed Central Artery to North Station.

4. **Underground People Mover**: Operation of AGT vehicles in tunnel between the World Trade Center and South Station with two possible downtown alignments: (1) under Essex Street to a station located between Chinatown (Orange Line) and Boylston (Green Line) Stations, or (2) under Washington Street to Downtown Crossing (Orange Line) where an underground walkway provides access to the Green Line at Park Street Station.

5. **Guided Bus**: Guided buses operated on an elevated single-track guideway in the Piers area with connections to South Station via the Seaport Access Road and the Boylston (Green Line) and New England Medical Center (Orange Line) Stations via surface streets or a tunnel beneath the Massachusetts Turnpike.

6. **Relocated Red Line**: Diversion of the Red Line heavy rail system between Broadway and South Stations, following the alignment of either the Seaport Access Road or the South Boston Conrail Cut, with a new station located in the Piers area.

The feasibility study concluded that substantial public transportation improvements would be required to support proposed development in the South Boston Piers area. Based on analysis of the six alternatives described above in terms of transit right-of-way, ridership, cost, implementation, and urban design issues, it was recommended that a formal environmental impact analysis be initiated to enable a comprehensive evaluation of viable alternatives.

2.2.2 Inputs from the Draft Environmental Impact Report (DEIR)

Based on the conclusions and recommendations of the feasibility study, a Draft Environmental Impact Report (DEIR)[2] was initiated in the fall of 1987 pursuant to the requirements of the Massachusetts Environmental Policy Act (MEPA). The DEIR was intended to provide a conceptual analysis of various long-term approaches for the extension of transit service to the South Boston Piers area. An Environmental Notification Form (ENF) was noticed in the *Environmental Monitor* on November 12, 1987, and two state scoping meetings were held on December 10, 1987 at the Federal Reserve Building. As a result of this state scoping process, the MBTA was directed by the Secretary of the Massachusetts Executive Office of Environmental Affairs to prepare a DEIR analyzing the following seven alternatives:

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[2] Massachusetts Bay Transportation Authority. *South Boston Piers/Fort Point Channel Alternatives Draft Environmental Impact Report*. EOEA Number 6826. Prepared by URS Consultants, Inc. September 1989.

1. **No Action**: Incremental increases in current bus routes.

2. **Bus/TSM**: High frequency shuttle bus service from South Station, Park Square, and North Station to the Piers area, including transportation system management (TSM) actions such as underground exclusive bus lanes from the Seaport Access Road and New Congress Street to a subsurface bus terminal located between Congress Street and New Northern Avenue.

3. **At-Grade Light Rail**: Articulated light rail vehicles operating on a surface transit reservation between the Boston Marine Industrial Park (BMIP) and Dewey Square initially, with a later at-grade extension above the depressed Central Artery to North Station. A temporary viaduct would be required between Dewey Square and Northern Avenue, as well as a permanent bridge across Fort Point Channel. Intermediate stops would be located at the World Trade Center, Fan Pier/Pier 4, International Place/Rowes Wharf, Aquarium Station, and Haymarket/Hanover Street.

4. **Elevated People Mover**: Small, automatically controlled vehicles operating on an elevated guideway between Boylston Station in the west and BMIP in the east.

5. **Fort Point Channel Underground Transitway**[3]: Automated subway cars, light rail vehicles, or buses operating subsurface between BMIP, South Station, and Boylston Station, with intermediate stops at the World Trade Center and Fan Pier/Pier 4. This alternative could be constructed incrementally, with an initial bus tunnel from South Station, under Atlantic Avenue above the depressed northbound Central Artery, and under Fort Point Channel to the vicinity of Fan Pier. Bus technology permits a connection to Washington Street Replacement Transit Service using either trackless trolleys (electric buses) or dual mode (electric/diesel) buses. Light rail technology permits a connection to the Green Line Central Subway at Boylston Station. The use of either light rail or bus technology would make surface operation in parts of the Piers area feasible in the long-term as well, particularly in the less densely developed area east of the World Trade Center. People movers, because of their automated mode operation, cannot operate on the surface in mixed vehicular and pedestrian traffic.

6. **Red Line Loop**: Diversion of the existing Red Line heavy rail system between Broadway and South Stations, under the Seaport Access Road to a new station located under the East Service Road.

7. **South Station/South Boston Rail Shuttle**: Operation of commuter rail service via the restored Old Colony Line and the South Boston Conrail cut.

Two of these alternatives — the Elevated People Mover and the South Station/South Boston Rail Shuttle — were considered in the early phases of the DEIR and then dropped from further analysis. The Elevated People Mover was advanced from the feasibility study on the condition that: (1) a connection be provided to the Orange and Green Lines to maximize transit mode share and (2) the visual and aesthetic impacts be considered acceptable. A connection to the Orange and Green Lines was proposed which involved extending the line west on Essex Street from South Station to intersect with Boylston and Chinatown Stations. However, community reaction to the visual impacts of this alternative was uniformly negative. Specifically, objections were raised by the Sleeper Street and Chinatown residential communities, the Massachusetts Historical Commission, the Federal Reserve Bank, and the two major public landowners in the South Boston Piers area, the Massachusetts Port Authority and the City of Boston Economic Development and Industrial Corporation (EDIC). Consequently, this alternative was eliminated from further consideration. The South Station/South Boston Rail Shuttle was also eliminated, due to operational constraints that prevented it from attracting a transit mode share competitive with the other alternatives.

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[3] This alternative was referred to in the feasibility study as the *Underground People Mover.* The name was changed in the DEIR to reflect the variety of mass transit technologies that could be operated in the Transitway tunnel.

The DEIR analyzed the five remaining alternatives according to four evaluation criteria:

- **Effectiveness**: The extent to which each alternative achieves the goals of the project classified in terms of staged implementation, expansion potential, transportation impacts, integration with MBTA services, and timely implementation.

- **Environmental Impacts**: Short-term construction and permanent long-term impacts of each alternative in seven categories, including land use and neighborhoods, visual and aesthetic, air quality, noise and vibration, ecosystems and water resources, historic and archaeological, and parklands.

- **Financial Feasibility**: Total and annual capital and operating and maintenance costs of each alternative measured against known funding sources.

- **Cost-effectiveness**: The cost of each alternative in comparison to ridership increases and travel time savings.

The DEIR was circulated in the fall of 1989 to Massachusetts government agencies, interested organizations, and citizens. In this document, the analysis methodologies and results were summarized and further screening of alternatives was described. Based on such analyses and screening, the Fort Point Channel Underground Transitway using either trackless trolleys or dual mode buses was designated as the locally preferred alternative; the Transitway tunnels would be designed to accommodate a future conversion to light rail technology should this be required by changes in land use patterns and demand. The major disadvantages of the other alternatives are summarized in Table 2-1. A complete description of the impacts of each alternative and the evaluation process leading to the selection of the Transitway as the preferred alternative is provided in the DEIR.

The Certificate of the Secretary of Environmental Affairs on the transit project concurred with selection of the Fort Point Channel Underground Transitway as the preferred alternative. The Secretary agreed with results of the analysis presented in the DEIR and directed the MBTA to carry only the Transitway to a higher level of analysis in the concluding stage of the state environmental review process as documented in the Final Environmental Impact Report (FEIR). Prior to initiation of the FEIR, however, the MBTA submitted an application to the Federal Transit Administration (FTA, formerly the Urban Mass Transportation Administration) to advance the South Boston Piers/Fort Point Channel Transit Project into the federal alternatives analysis/Draft Environmental Impact Statement (AA/DEIS) process. The advancement of the project into this federal process is described in the following section.

2.2.3 Results of Project Scoping and Screening of Alternatives

In August 1990, the MBTA's application to advance the South Boston Piers/Fort Point Channel Transit Project was approved by the FTA. Based on the analysis and results of the DEIR, a subset of alternatives was recommended for analysis as part of the federal process. A Notice of Intent describing the project and the alternatives to be analyzed was published in the *Federal Register* on October 23, 1990.

Given the two years that had lapsed since publication of the project's DEIR, the MBTA and MEPA agreed that the DEIS would also serve as a supplement to the earlier DEIR. Following a federal scoping session held on November 8, 1990 at South Station, Boston, the following alternatives were identified for further analysis in the DEIS/SDEIR:

1. **No Action**: Minor modifications to existing MBTA routes serving the Piers area to respond to demand generated by new development.

2. **Surface Bus/Transportation System Management (TSM)**: More aggressive surface bus service that utilizes TSM techniques to further enhance the effectiveness and efficiency of bus operations.

TABLE 2-1: MAJOR DISADVANTAGES OF ALTERNATIVES SCREENED FROM THE DEIR

Alternative	Disadvantage
No Action	· Low transit mode share/unacceptable traffic conditions
Bus/TSM	· High surface bus volumes · Lower transit mode share than fixed-guideway alternatives
At-Grade Light Rail	· Possible urban design impacts on Central Artery reservation · Possible need for permanent elevated or subsurface structure between Dewey Square and Northern Avenue · High surface bus volumes in Chinatown and on Fort Point Channel bridges · Lower transit mode share than Transitway due to less effective downtown transit connections · Delay in construction of North Station connection
Red Line Loop	· Cannot be expanded or built incrementally · Requires initial capital investment of over $300M (1988 dollars) · Single station limits service potential and requires high surface bus volumes · Poor cost-effectiveness rating due to negative impact on Red Line south corridor riders destined for downtown

3. **Fort Point Channel Underground Transitway**: Operation of either trackless trolleys or dual mode buses in tunnel between downtown and the South Boston Piers area. Three termini options — full build and two shorter minimum operable segments (MOS) — are analyzed as separate alternatives:

   a. Boylston Station to World Trade Center (Full Build)

   b. South Station to Fan Pier (MOS-1)

   c. South Station to World Trade Center (MOS-2)

The progression of alternatives from the feasibility study to the DEIS/SDEIR is depicted in Figure 2-1.

2.3 ALTERNATIVES ANALYZED

In this section, the alignments, service plans, operating strategies, and designs of the No Action, Bus/TSM, and Transitway Alternatives are described.

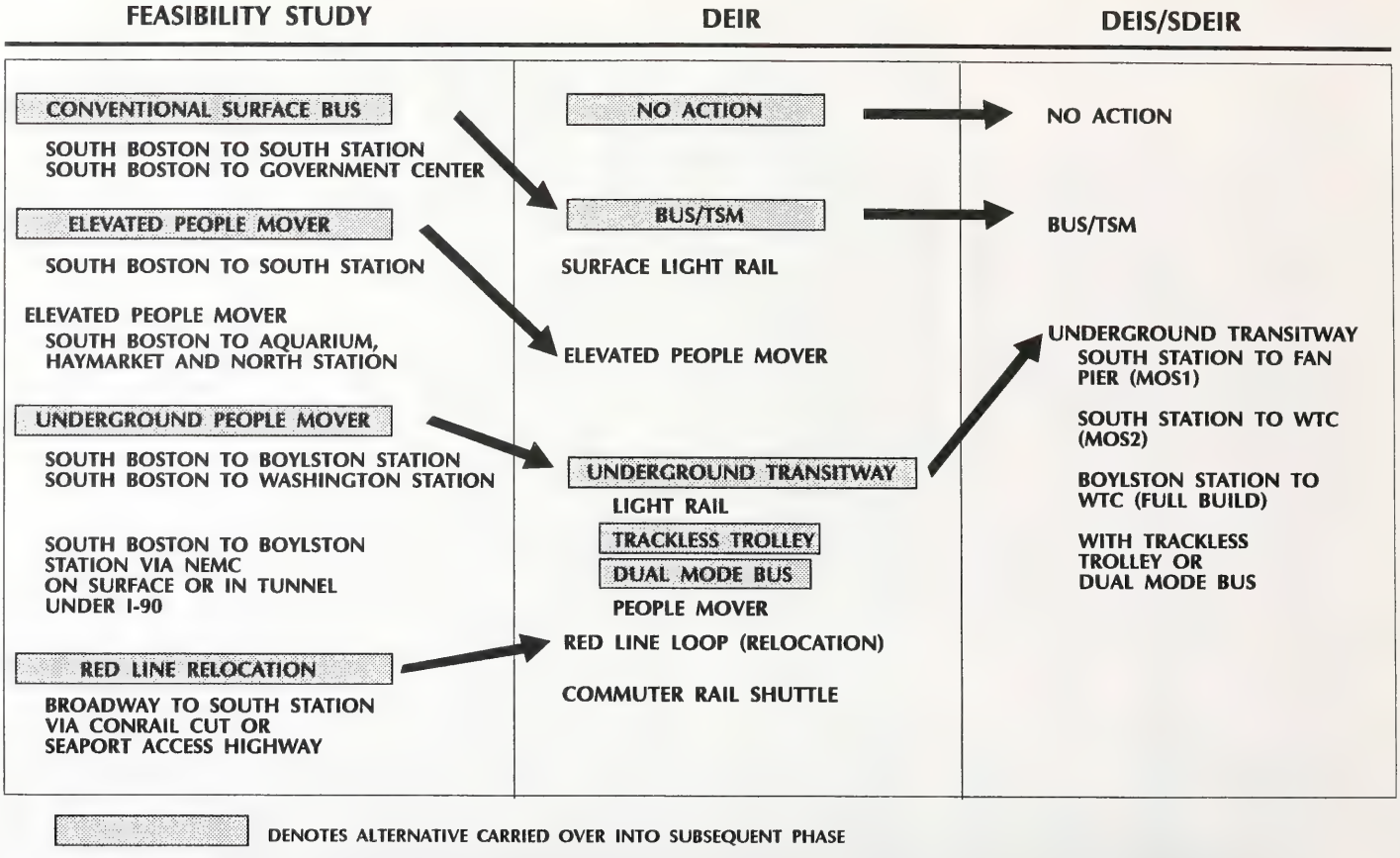
FEASIBILITY STUDY
DEIR
DEIS/SDEIR
CONVENTIONAL SURFACE BUS
SOUTH BOSTON TO SOUTH STATION
SOUTH BOSTON TO GOVERNMENT CENTER
ELEVATED PEOPLE MOVER
SOUTH BOSTON TO SOUTH STATION
ELEVATED PEOPLE MOVER
SOUTH BOSTON TO AQUARIUM, HAYMARKET AND NORTH STATION
UNDERGROUND PEOPLE MOVER
SOUTH BOSTON TO BOYLSTON STATION
SOUTH BOSTON TO WASHINGTON STATION
SOUTH BOSTON TO BOYLSTON STATION VIA NEMC ON SURFACE OR IN TUNNEL UNDER I-90
RED LINE RELOCATION
BROADWAY TO SOUTH STATION VIA CONRAIL CUT OR SEAPORT ACCESS HIGHWAY
NO ACTION
BUS/TSM
SURFACE LIGHT RAIL
ELEVATED PEOPLE MOVER
UNDERGROUND TRANSITWAY
LIGHT RAIL
TRACKLESS TROLLEY
DUAL MODE BUS
PEOPLE MOVER
RED LINE LOOP (RELOCATION)
COMMUTER RAIL SHUTTLE
NO ACTION
BUS/TSM
UNDERGROUND TRANSITWAY
SOUTH STATION TO FAN PIER (MOS1)
SOUTH STATION TO WTC (MOS2)
BOYLSTON STATION TO WTC (FULL BUILD)
WITH TRACKLESS TROLLEY OR DUAL MODE BUS
DENOTES ALTERNATIVE CARRIED OVER INTO SUBSEQUENT PHASE

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Fig. 2-1
Progression of Alternatives Studied

2.3.1 No Action Alternative

Under the No Action Alternative shown in Figure 2-2, the MBTA would increase the frequency of existing bus routes in the area, expand service areas slightly, and make use of new road systems which presently are in an advanced stage of planning and design. This alternative does not include new facilities or routes but does include the acquisition of a small number of additional buses to operate on existing routes. Therefore, the No Action Alternative represents a minimal response to forecasted increases in demand for transit service that would be generated by development in the South Boston Piers area. As such, it is a reactive approach compared to the other alternatives.

Conventional bus service would be operated in the No Action Alternative. Standard capacity diesel buses as presently operated by the MBTA would be used. All new buses purchased for this service would be handicapped accessible consistent with current MBTA policy and Americans with Disabilities Act (ADA) requirements to procure only accessible vehicles. Headways would not be less than the current minimum of 3 minutes for regular route bus service provided by the MBTA. To exceed this informal policy standard would be to move toward an aggressive, shuttle-type bus service as defined in the Bus/TSM Alternative.

2.3.1.1 Routes in the No Action Alternative

Proposed street and highway improvements assumed in this alternative include New Northern Avenue and New Congress Street in addition to elements of the CA/T Project including East and West Service Roads, Seaport Access Road, and a Third Harbor Tunnel crossing.

Routes in the No Action Alternative would be limited to those currently operated by the MBTA. These routes would include Route 3, operating between Chinatown and the Boston Marine Industrial Park (BMIP), Route 6, operating between Haymarket Station and BMIP, and Route 7, operating between City Point and downtown Boston. These existing routes are shown in Figure 2-3. Slight modifications would be made to these current routes in order to better serve increased demand.

Route 7 would continue to link the residential areas of South Boston with downtown operating via South Station, Northern Avenue, D Street, and Summer Street. In the Piers area, Route 7 would be modified to operate entirely on D Street, as Ramp Street would no longer exist.

Route 6 would operate between North Station and BMIP serving New Congress Street, Sleeper Street, and New Northern Avenue. An extension of this route from Haymarket Station to North Station would facilitate transfers for commuter rail riders. From New Northern Avenue, Route 6 would continue to BMIP via Summer and D Streets, rather than the current routing via Ramp and Viaduct Streets.

Route 3 would continue to operate as a local bus service linking Chinatown and BMIP. The routing pattern for Route 3 would be changed to provide better access to the western Piers area. The revised Route 3 would circulate through the western Piers area outbound to BMIP using A Street, New Congress Street, West Service Road, New Northern Avenue, East Service Road, New Congress Street, C Street, Fargo Street, D Street, and Northern Avenue. Route 3 would follow D Street to New Northern Avenue in order to reach BMIP. The reverse direction from BMIP to Chinatown would be similar except that B Street and East Service Road would be used instead of West and East Service Roads, respectively, due to the paired configuration of one-way streets.

Route 3 would also be extended on its downtown end in order to facilitate transfers for Green Line riders. As modified, Route 3 would continue north of Kneeland Street on Washington Street to Essex Street. One block to the west of the intersection of Washington and Essex Streets is Boylston Station on the Green Line. Thus, while a direct connection between Route 3 and the Green Line would not be achieved, the distance between the two services would be a reasonable walk distance. Orange Line riders would be able to transfer to this bus at Chinatown or New England Medical Center Stations. Leaving Chinatown Station, Route 3 would traverse Essex Street to Harrison Avenue. At Harrison Avenue, Route 3 would travel south, cross Kneeland Street, and resume its current route towards South Boston.

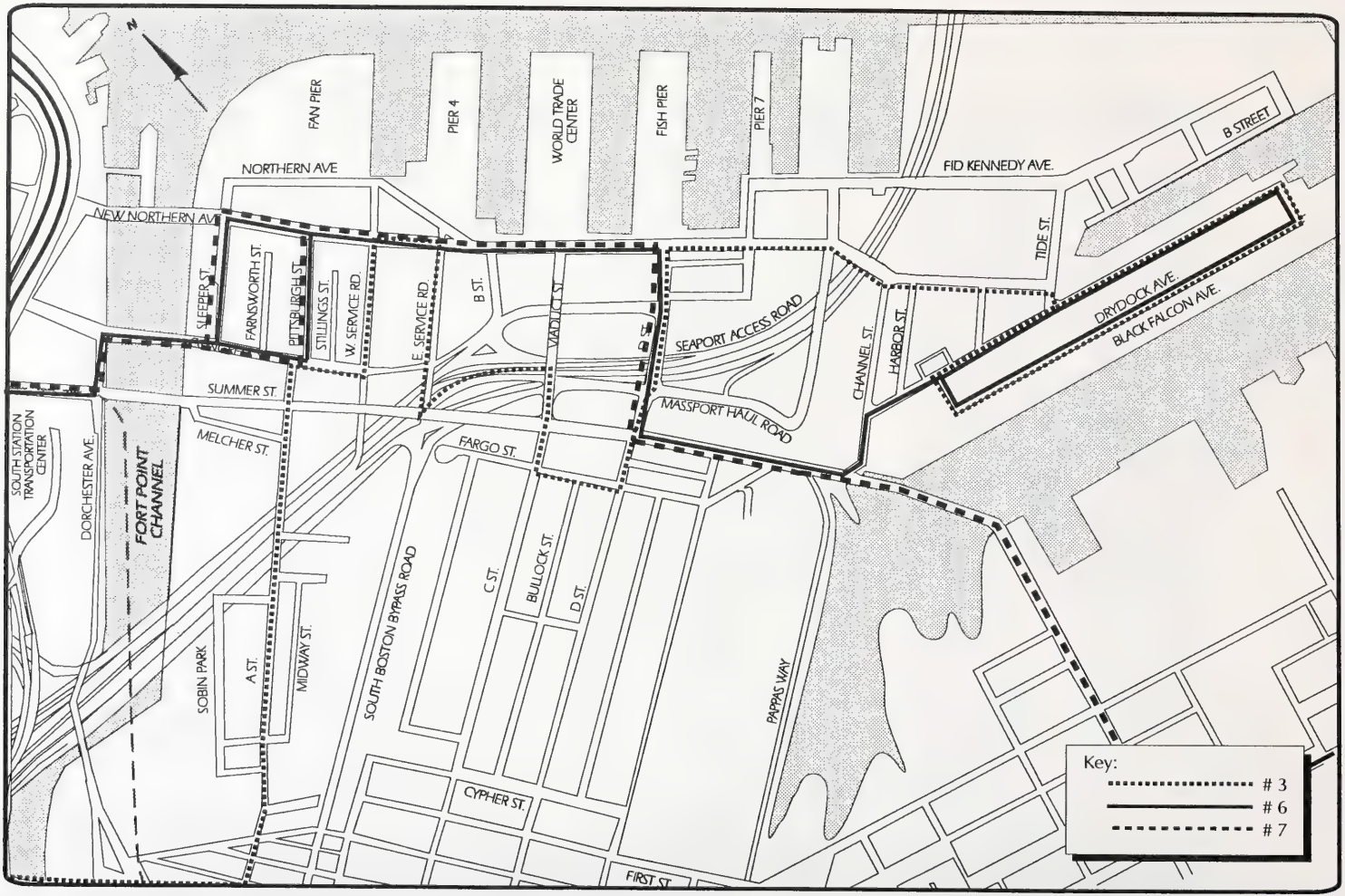

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Fig. 2-2, 1 of 2
Routes In No Action Alternative - Piers Area

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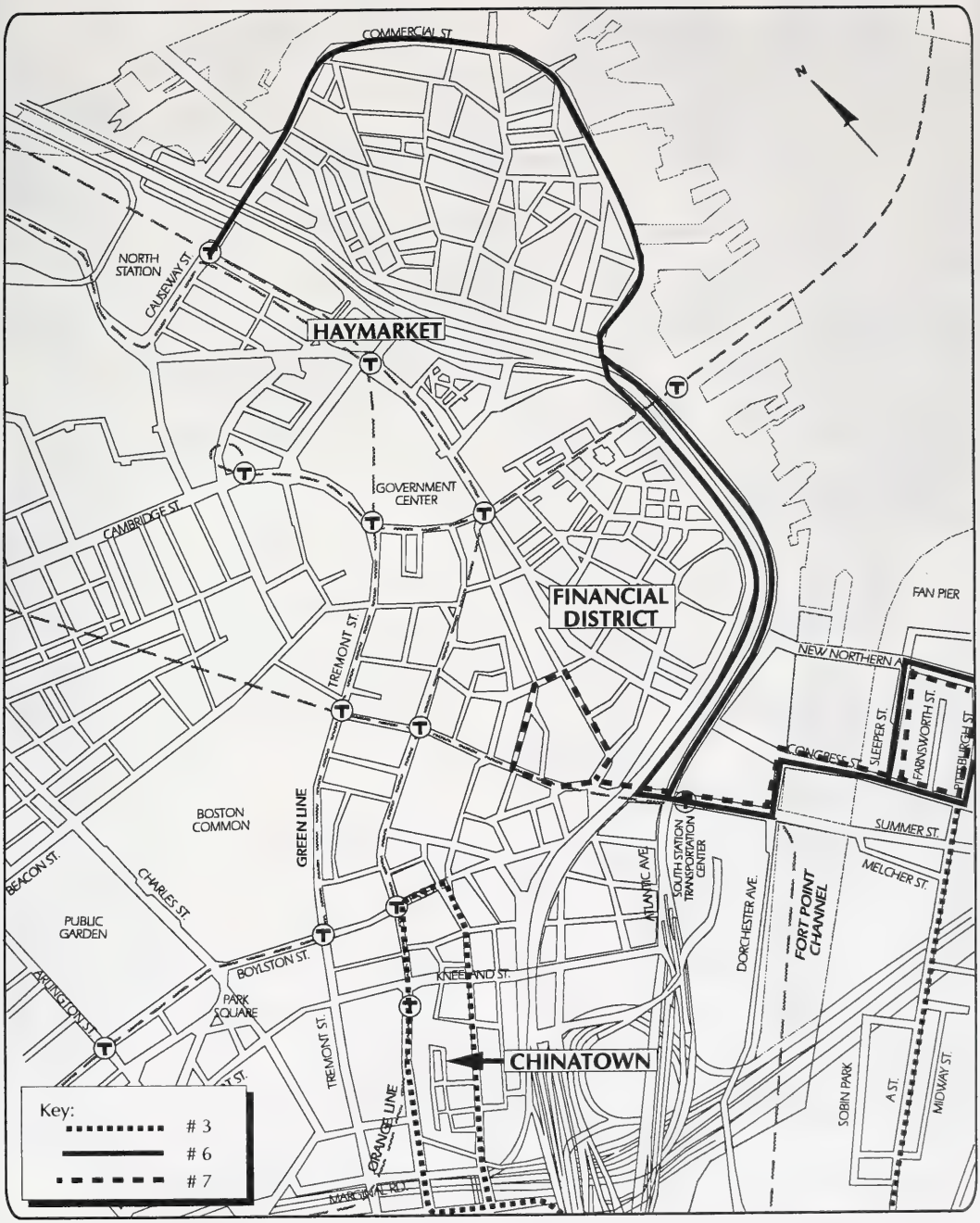
South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-2, 2 of 2
Routes In No Action Alternative
Downtown Area



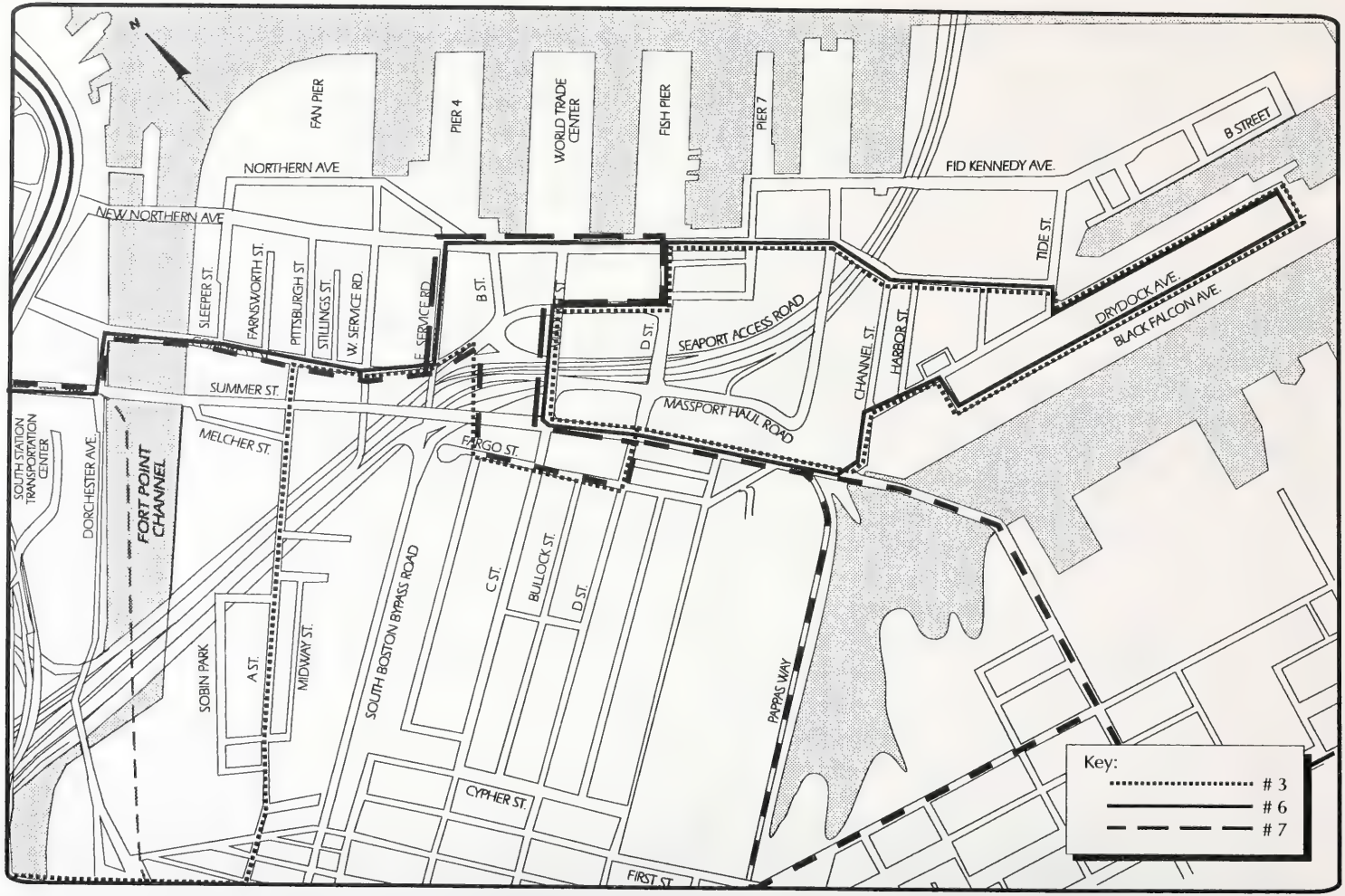


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Fig. 2-3, 1 of 2
Existing Bus Service - Piers Area

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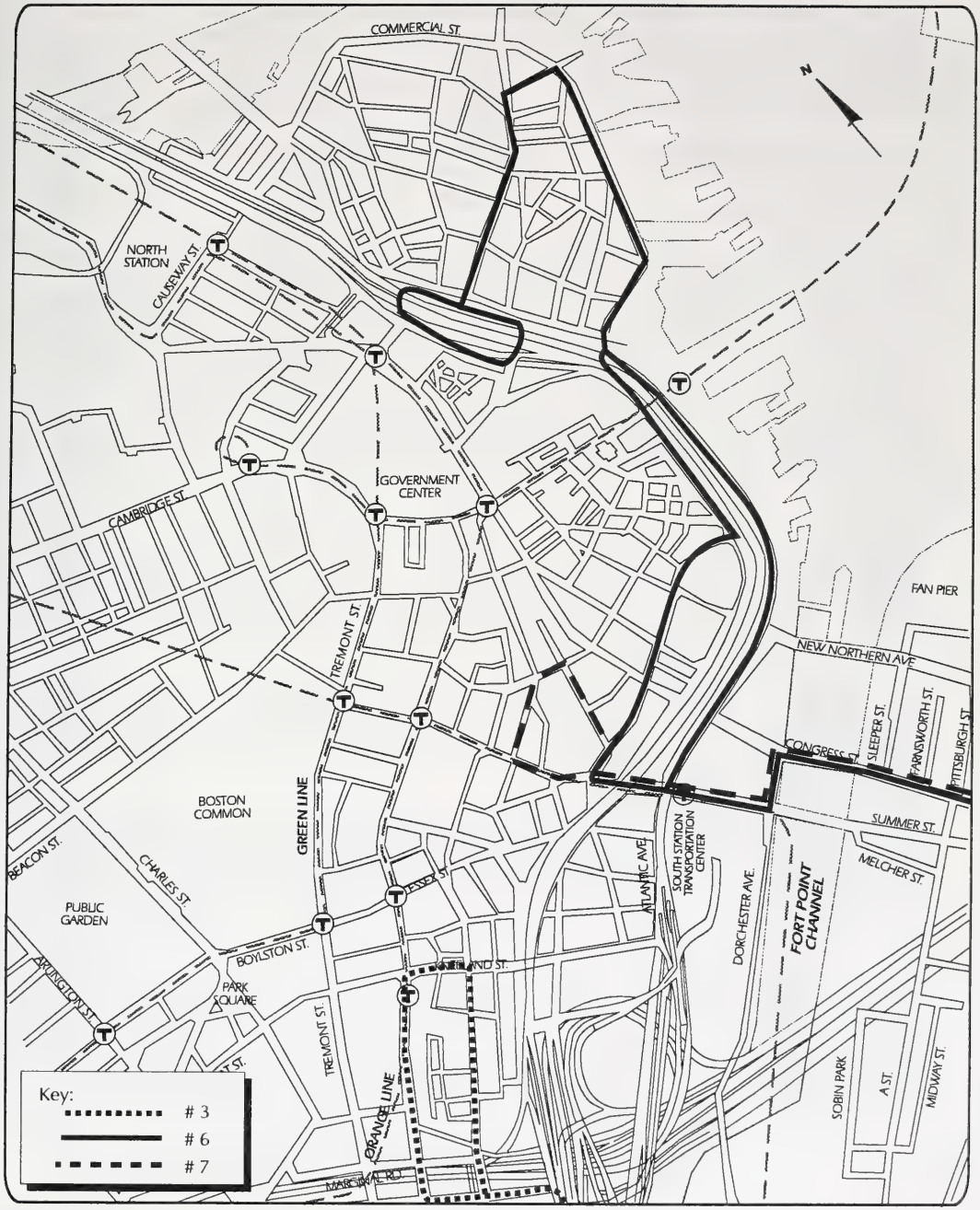
Fig. 2-3, 2 of 2
Existing Bus Service - Downtown Area



Operating speeds for all three routes have been estimated based on traffic conditions in similar areas of Boston that are already developed. For streets in the Piers area, an average speed of 6 miles per hour has been assumed to reflect buses operating in mixed traffic under moderate levels of congestion. In residential and industrial South Boston, a higher speed of 10 miles per hour was proposed to depict buses operating in developed areas with lesser levels of traffic congestion. Finally, buses operating in the BMIP area were estimated to achieve a speed of 12 miles per hour, due to the lower level of development (and consequently congestion) in that area. Downtown sections of routes operated in the No Action Alternative are assumed to operate at speeds similar to those achieved under existing conditions.

No express or high frequency shuttle service is included in the No Action Alternative, and most riders are expected to transfer at least once in order to reach the Piers area.

2.3.1.2 Travel Markets To Be Served

Table 2-2 summarizes routes in the No Action Alternative that would link major downtown transfer points and Piers area destinations. Direct service would be provided to several nearby urban neighborhoods — North End, Chinatown, Leather District, and South Boston — and key transfer stations — South Station, New England Medical Center, Chinatown, Aquarium, North Station, and Broadway Station. Rapid transit connections would be made by all three routes. Route 7 would provide Red Line connections at South Station, while Route 3 would offer Orange Line connections at New England Medical Center or Chinatown Station, and Red Line connections at Broadway Station. Route 6 would intercept the Orange Line and the Green Line at North Station, the Red Line at South Station, as well as the Blue Line at Aquarium Station. Green Line passengers could also walk one block from Boylston Station to transfer to Route 3 at Chinatown Station. Commuter rail transfers are provided at North Station and South Station.

2.3.1.3 Level of Service Proposed

Due to the limited number of routes to be operated and higher levels of demand projected, service would operate more frequently than is currently provided. However, limitations on storage and maintenance capacity would in turn hinder service expansion. There presently is no significant additional storage capacity at existing MBTA facilities in the area. MBTA operations staff indicate that perhaps a maximum of twenty additional vehicles could be accommodated at Cabot Garage under the most optimistic plans to expand MBTA facilities and reassign some routes.

Given this constraint, there is no difference in the level of service provided by the No Action Alternative between the high and lower growth scenarios. Table 2-3 shows the routes to be operated in the No Action Alternative, along with their proposed and current headways and frequencies. All routes would be operated with standard size transit buses.

Routes and headways presented in Table 2-3 could be accomplished with an estimated thirty additional buses including spares. The No Action Alternative could be implemented in stages by calibrating annual vehicle procurement to meet anticipated increases in demand, consistent with available funding. The level of service is consistent with capacity constraints at existing and planned MBTA maintenance facilities described above.

2.3.1.4 Fare Collection

Fare collection methods would be the same as for other MBTA surface bus routes. Fare collection would be by means of payment of a cash fare or token when boarding the bus, or use of a monthly pass. Current MBTA fare policies are assumed to remain in effect, including free transfers between rapid transit lines and no free transfers to surface bus routes. No special fare policies or payment plans are anticipated for service proposed in the No Action Alternative, nor would fares differ by time of day, consistent with current MBTA fare policy.

TABLE 2-2: ROUTES SERVING MAJOR ORIGIN-DESTINATION PAIRS

Transfer Station	Connecting Services	Fan Pier/ Federal Courthouse	World Trade Center	Summer Street Offices	Boston Marine Industrial Park
North Station	Green Line, Orange Line, Commuter Rail/Bus	Route 6	Route 6	Route 6	Route 6
Aquarium Station	Blue Line	Route 6	Route 6	Route 6	Route 6
South Station	Red Line, Commuter and Intercity Rail/Bus	Route 7	Routes 6 and 7	Route 7	Route 6
New England Medical Center Station	Orange Line	Route 3	Route 3	Route 3	Route 3
Chinatown Station	Orange Line, Green Line (one block from station)	Route 3	Route 3	Route 3	Route 3
Broadway Station	Red Line	Route 3	Route 3	Route 3	Route 3

TABLE 2-3: ROUTES AND HEADWAYS IN THE NO ACTION ALTERNATIVE

Route Description	Current Headway (minutes)	Proposed Headway (minutes)	Current Buses Per Hour	Proposed Buses Per Hour
Chinatown Station to BMIP (Route 3)	22	10	2	6
North Station to BMIP (Route 6)	30	10	2	6
South Station to BMIP (Route 6)	15	*	4	*
City Point to Downtown (Route 7)	14	5	4	12

* Provided by service originating at North Station

2.3.1.5 Capital Requirements

Capital requirements of the No Action Alternative would be limited to those expenditures required for the expansion of bus service as a result of increased demand. No new maintenance or storage facilities are programmed. The major capital cost component is the acquisition of vehicles. Due to the modest expansion of service anticipated in the No Action Alternative, bus procurement would be minimal. Thirty additional vehicles (including spares) would be required to operate the expanded service; a modest number of additional passenger shelters would be constructed to support this expanded service.

2.3.2 Bus/TSM Alternative

A Surface Bus/Transportation System Management (TSM) Alternative has been developed to increase transit mode share by providing a maximum feasible level of bus service on available streets and highways. As shown in Figures 2-4 and 2-5, buses in this alternative would circulate through the Piers area in a dispersed loop pattern: bus routes are planned to use various streets to reach major activity centers, depending upon their origin and type of service provided. This pattern would provide maximum distribution throughout the Piers area, minimizing bus congestion on surface streets. Nonetheless, a significant volume of buses would be operated through the Piers area under the Bus/TSM Alternative, especially along New Congress Street. In order to more efficiently route these buses through the Piers area, several different TSM measures would be applied. These TSM measures would include the use of articulated buses on some services and utilization of bus lanes where appropriate. In addition, anticipated ridership volumes indicate the need for dedicated passenger facilities in two locations in the Piers area, one near Fan Pier and the other near World Trade Center. These handicapped accessible facilities would consist of a modest structure, equipped with a sheltered waiting area, restrooms, and change and information booth to facilitate passenger usage of the facility. A third passenger facility would be needed in the downtown area on Oak Street. This facility would be smaller than the Piers area facilities and would consist of an unmanned, partially enclosed structure designed to accommodate those passengers transferring from the Orange Line at New England Medical Center Station.

Articulated buses would be used on several routes that are planned to operate at short headways and that carry a significant number of riders. Several of the proposed routes in the Bus/TSM Alternative are shuttle routes linking rapid transit stations with the Piers area. Consequently, shuttle routes are candidates for the use of articulated buses. Other routes, such as the express routes to the Piers area and most local routes, would use conventional buses since the anticipated ridership and resulting bus volumes on those routes are not as great. Nonetheless, the use of articulated buses on the shuttle routes would keep the total volume of buses in the Piers area within manageable levels as compared to the use of conventional buses on all routes.

Another TSM measure aimed at controlling the number of buses on surface streets is utilization of bus lanes. A bus lane would be implemented under the high growth scenario in the Piers area along New Congress Street between D Street and West Service Road, in the westbound direction only. Because this section of New Congress Street is anticipated to have volumes of approximately 60 buses per hour in the high growth scenario, bus traffic and general traffic would benefit from the inclusion of a bus lane. This bus lane is described in greater detail later in this section. Comparable bus volumes in the lower growth scenario would be only 45 buses per hour, and in this situation, construction of a bus lane is not warranted; ***however, right-of-way would be reserved to enable future construction of this lane as demand increases.***

2.3.2.1 Routes in the Bus/TSM Alternative

Bus routes in the Bus/TSM Alternative include shuttle, local, and express routes. Due to the uncertainty in development forecasts for 2010, operating plans were developed for both the high growth and lower growth ridership and development scenarios. Bus routes for these operating plans are summarized in Table 2-4. In the lower growth scenario, no express bus routes would be operated.

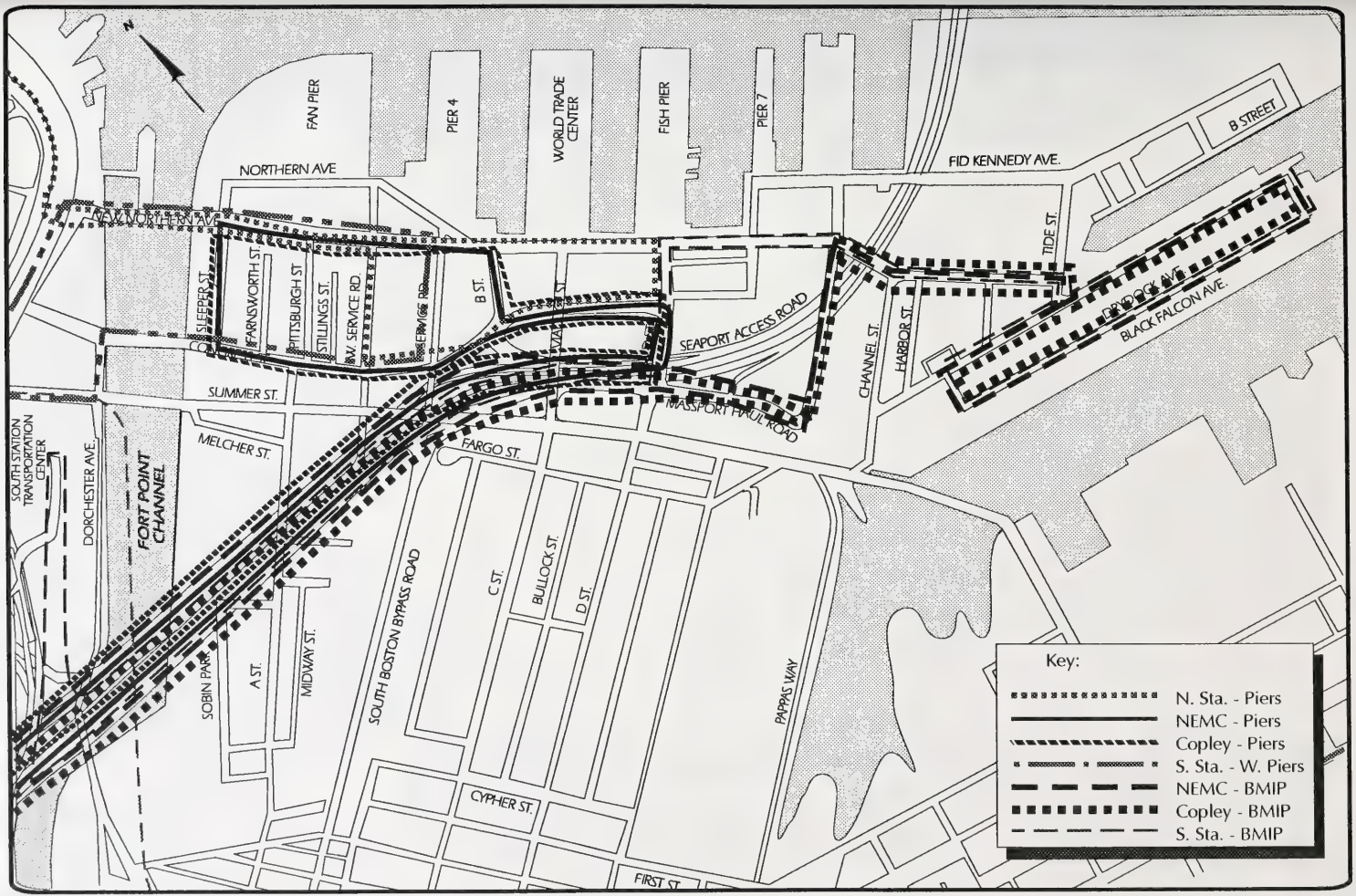


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Fig. 2-4, 1 of 3
Bus/TSM Alternative
Piers Area Shuttle Routes

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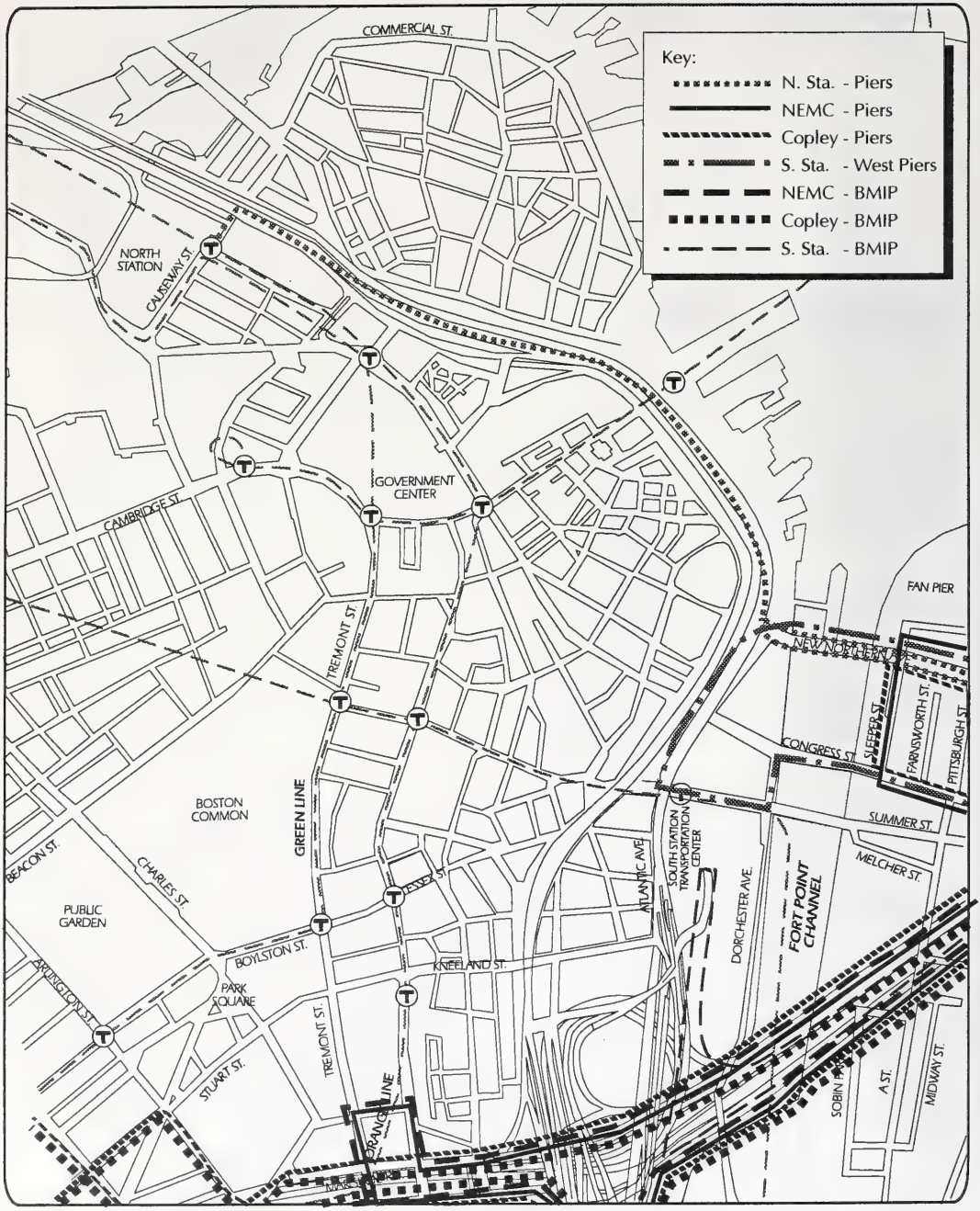
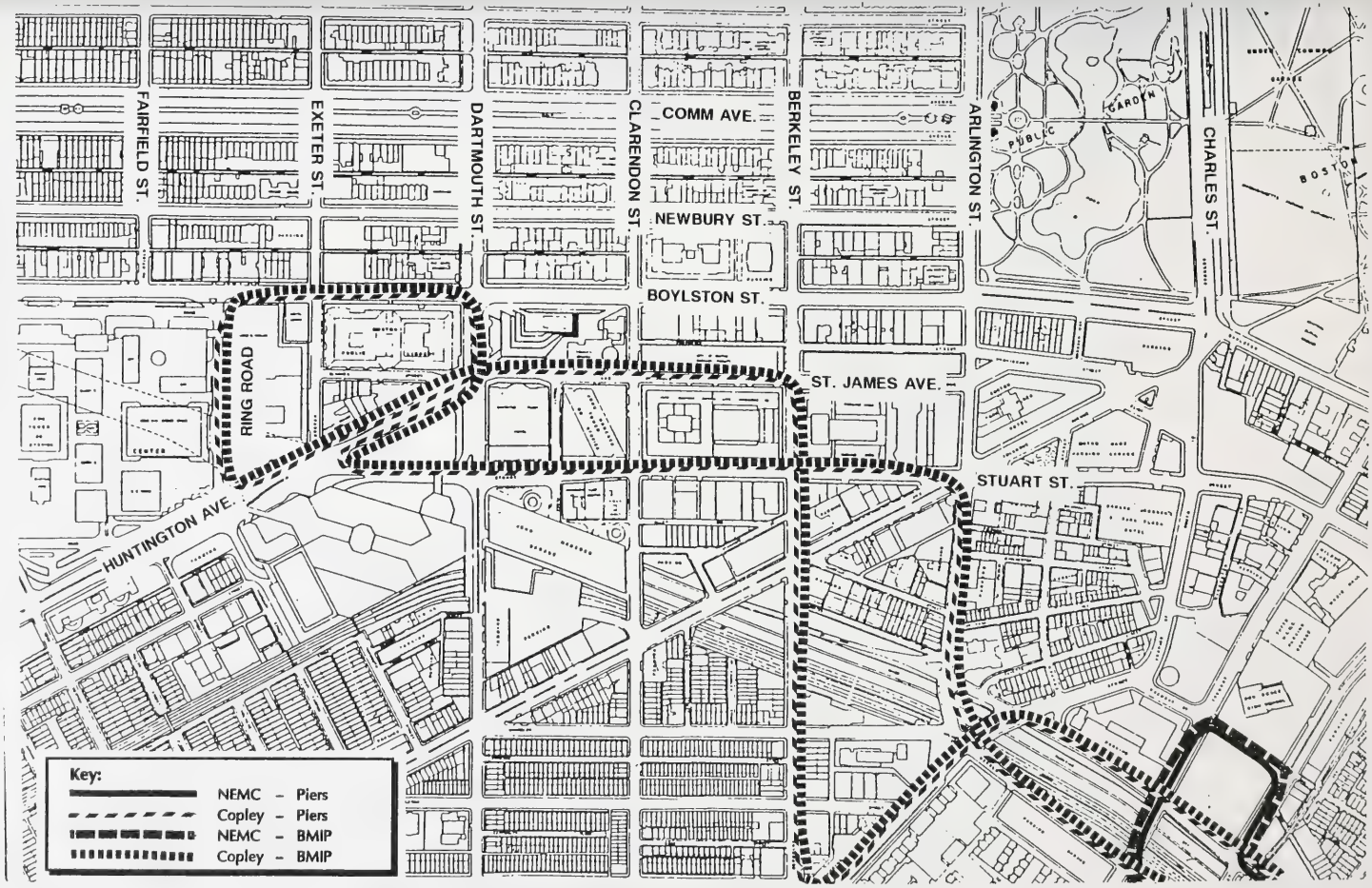
Fig. 2-4, 2 of 3
Bus/TSM Alternative
Downtown Area
Shuttle Routes





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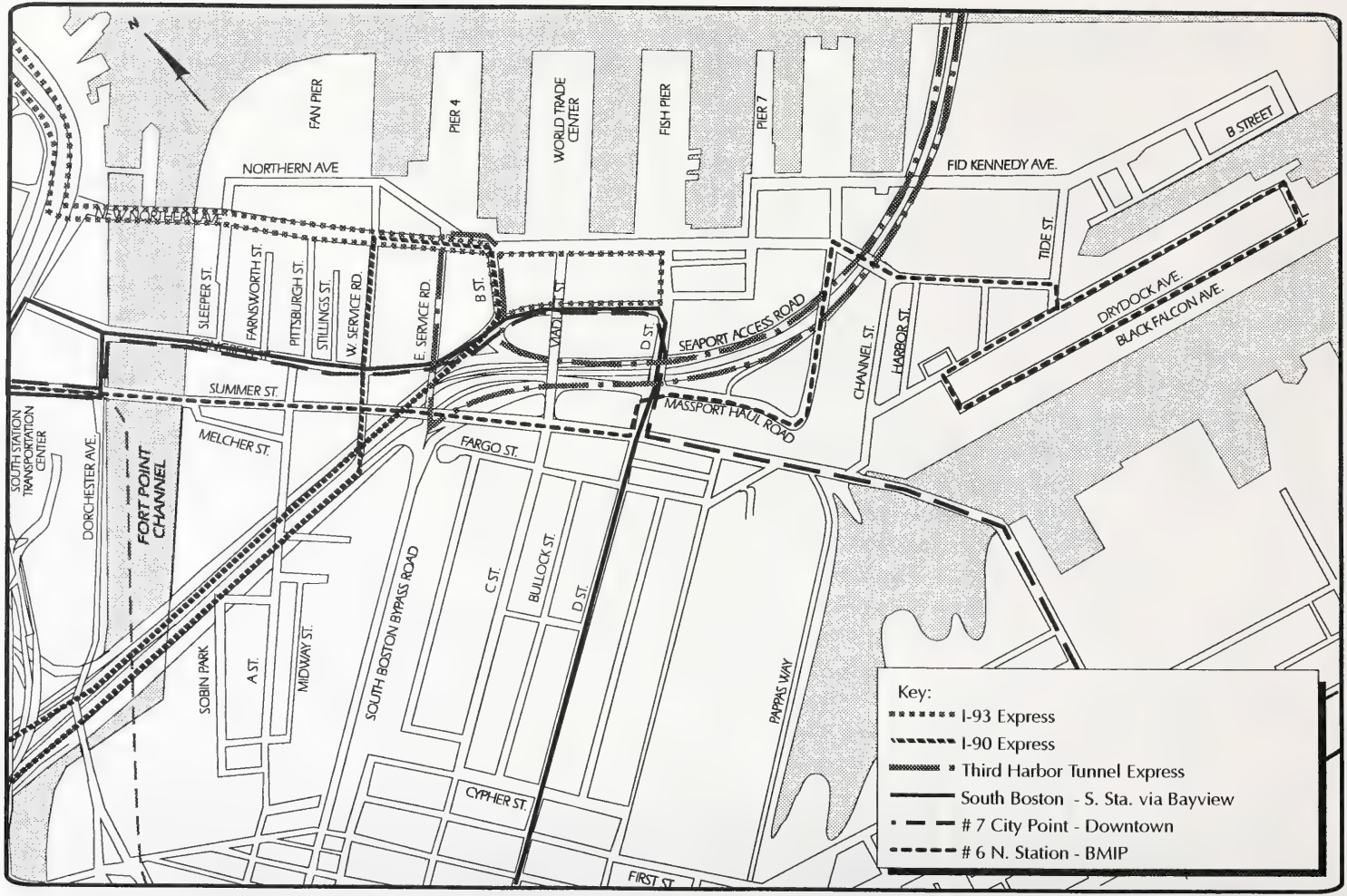
South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-4, 3 of 3
Bus/TSM Alternative Back Bay - South End Area Shuttle Routes



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South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-5, 1 of 2
Bus/TSM Alternative - Piers Area
Express and Local Routes

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Fg. 2-5, 2 of 2
Bus/TSM Alternative
Downtown Area
Express and Local
Routes

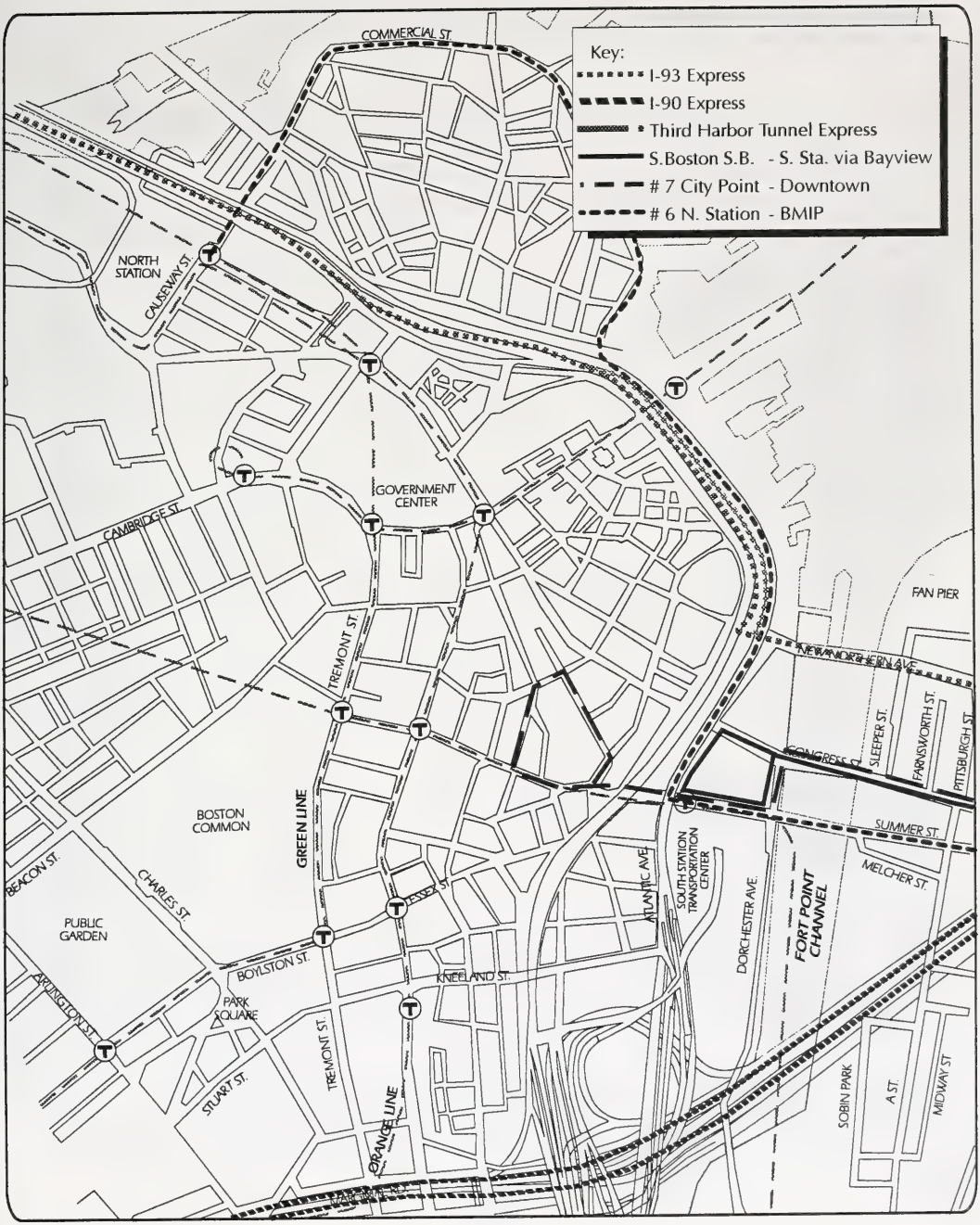

TABLE 2-4: BUS ROUTES IN THE BUS/TSM ALTERNATIVE

Route Description	Type of Route	2010 Lower Growth Estimated Buses Per Hour	2010 High Growth Estimated Buses Per Hour
North Station to Piers Area	Shuttle	20	20*
South Station to West Piers Area	Shuttle	8	8
South Station to East Piers/BMIP	Shuttle	8	9*
New England Medical Center to Piers Area	Shuttle	8	8
New England Medical Center to BMIP	Shuttle	8	8
Copley to West Piers Area	Shuttle	8	8
Copley to East Piers/BMIP	Shuttle	8	8
North Station to BMIP (Route 6)	Local	8	9
South Boston to Downtown (Route 7)	Local	6	6*
South Boston to South Station via Bayview	Local	4	4
Via I-93 Burlington/Mishawum to Piers Area	Express	0	8
Via I-90 (Massachusetts Turnpike) Allston/Reservoir Watertown/Waltham	Express	0	8
Via Third Harbor Tunnel Orient Heights/Winthrop Lynn/Salem Revere/Malden Chelsea/Everett	Express	0	20

* Articulated buses to be used on these routes.

Shuttle Routes

As shown in Figure 2-4, shuttle routes are planned to link four downtown rapid transit stations — North Station, South Station, New England Medical Center Station, and Copley Station — with the Piers area. Separate routes serving the Piers area and BMIP would originate at all rapid transit stations except North Station.

The North Station route would provide connections to the Green and Orange Lines in addition to commuter rail from the north, and would also intercept the Blue Line at Aquarium Station. Shuttle routes originating at South Station would provide connections to the Red Line as well as commuter rail and express bus services from the south and west. Connections to the Green Line for traveler from the west would be made by the two routes originating at Copley Station, while passengers from southern points served by the Orange Line would transfer to shuttle buses at New England Medical Center. The shuttle routes are planned to operate at headways ranging between 6 and 8 minutes.

From North Station, a single shuttle route would provide service along the Surface Artery and Atlantic Avenue, crossing the Fort Point Channel on New Northern Avenue. The route would then continue along New Northern Avenue to D Street. From D Street, it would operate along New Congress Street and West Service Road, return to New Northern Avenue, and retrace its previous routing to North Station. Stops would be located along New Northern Avenue in the vicinity of Fan Pier, along East Service Road, at D Street, and on New Congress Street at B Street and West Service Road. On its return trip to North Station, this route would stop again at Fan Pier to board passengers.

Although a new shuttle route is not planned to provide service to BMIP from North Station, that market would be served by a modified Route 6 which would bypass the West Piers area. The modified Route 6 is described in the "Local Routes" section below.

Two shuttles would operate from South Station. One would provide service to the West Piers area, while the other would serve BMIP. The South Station to West Piers route would follow a relatively direct route along East Service Road, New Congress and Congress Streets, Dorchester Avenue, and Summer Street. Stops in the Piers area would be provided at Fan Pier and along Congress Street.

The BMIP shuttle would originate in the South Station Transportation Center bus terminal and travel via the Seaport Access Road to D Street, thus avoiding the West Piers area. From D Street, the BMIP shuttle would travel along Northern Avenue and circulate through BMIP along Drydock and Black Falcon Avenues. Along Northern Avenue and within BMIP, this shuttle would observe existing MBTA stops.

Passengers transferring from the Orange Line (south) at New England Medical Center would also be served by two shuttle routes. Both routes would proceed from a passenger facility on Oak Street via Tremont Street/Shawmut Avenue to Herald Street in order to reach the Seaport Access Road. No stops would be made between Oak Street and the Piers area. The two shuttles would exit the Seaport Access Road to enter the Piers area in the vicinity of the western endpoint of the Massport Haul Road. At this point, the two shuttle routes would diverge.

Once it exits the Seaport Access Road, the West Piers shuttle would circulate westbound through the Piers area via New Congress Street, B Street, and New Northern Avenue. At the intersection of New Northern Avenue and Sleeper Street, the shuttle would return to New England Medical Center Station via Sleeper Street, Congress and New Congress Streets, D Street, the Seaport Access Road, Marginal Road, and Washington Street. Stops would be made at New Congress and B Streets, Fan Pier, and along New Congress Street at West Service Road and at D Street.

The New England Medical Center to BMIP shuttle would operate along the Massport Haul Road to Northern Avenue. This route would continue along Northern Avenue and circulate through BMIP using Drydock and Black Falcon Avenues. Along Northern Avenue and within BMIP, this route would observe existing MBTA posted stops.

The two routes designed to serve Green Line (west) passengers would intercept that service at Copley Station. Boardings would occur along Dartmouth Street at the Boston Public Library between Boylston Street and Huntington Avenue. The routes would follow Stuart and Arlington Streets, until the intersection of Arlington and Herald Streets, where the two routes would diverge. The Copley to West Piers route would follow the same streets as the New England Medical Center to West Piers route described above. Similarly, the Copley to BMIP route would follow the same streets as the New England Medical Center to BMIP route. In the reverse direction, buses would leave the Seaport Access Road at Marginal Road and operate to Copley Station via Tremont Street, Berkeley Street, St. James Street, Huntington Avenue, Ring Road, and Boylston Street to the Dartmouth Street terminus. The only stop on the two Copley routes west of the Fort Point Channel would be at Dartmouth Street in Copley Square.

Local Routes

Local routes in the Bus/TSM Alternative shown in Figure 2-5 represent modifications to existing MBTA routes. Route 7 from residential South Boston to downtown would be modified slightly to allow South Boston residents access to new developments in the Piers area. An additional local route from South Boston to South Station (designated "Bayview" but differing from the current Bayview Route 11) would also supplement the service provided by Route 7, offering access from western South Boston. Local service on Route 6 from North Station to BMIP would bypass the Fan Pier and World Trade Center areas of the Piers area offering service exclusively to persons traveling to BMIP. The local routes would not operate as frequently as the shuttle routes; their headways would be between 6.7 and 15 minutes. Outside of the Piers area, these routes would observe current MBTA posted stops. For Route 7 and the South Boston to South Station route, stops in the Piers area would be located at Summer and D Streets, and along New Congress Street at C Street, West Service Road, and Sleeper Street. For Route 6, no stops would be made until that route reaches the Massport Haul Road and Northern Avenue; from that point to BMIP, existing MBTA stops would be observed.

Express Bus Routes

Express service would not be operated in the lower growth scenario due to lower levels of development in the Piers area expected at that time. For the high growth scenario, express buses would be included due to the more intensive development projected. Such service is planned to originate in suburban areas where two or more transfers would otherwise be necessary to reach the Piers area via the existing transit network. Express routes in the downtown and Piers areas are shown in Figure 2-5; Figure 2-6 illustrates the regional routing of express routes.

On that portion of I-90 referred to as the Seaport Access Road in South Boston, the numerous proposed bus routes entering and exiting the highway from local streets in the area will, by necessity, utilize general purpose lanes on I-90. Beyond the South Boston area, bus movements on I-90 will utilize HOV lanes as available.

The express service defined in this alternative is consistent with the attempt to maximize mode share through the aggressive use of buses. Express service would be implemented in three corridors where highway access is good, yet where projected mode splits for transit are rather low. These corridors are the North Shore, the North Corridor (I-93), and the West Corridor (I-90). Seven express routes would be provided by the Bus/TSM Alternative.

From the North Shore, express buses would operate from Orient Heights and Winthrop; Lynn and Salem; Revere and Malden; and Chelsea and Everett. All North Shore express routes would utilize the Third Harbor Tunnel to reach the Piers area. Distribution in the Piers area would be from the Third Harbor Tunnel exit ramp to B Street, Northern Avenue, and East Service Road. From the intersection of East Service Road and New Congress Street, relatively direct access is available to the Third Harbor Tunnel eastbound. Passenger boarding and alighting for these express buses would be at limited locations; stops would likely be located on B Street and East Service Road.

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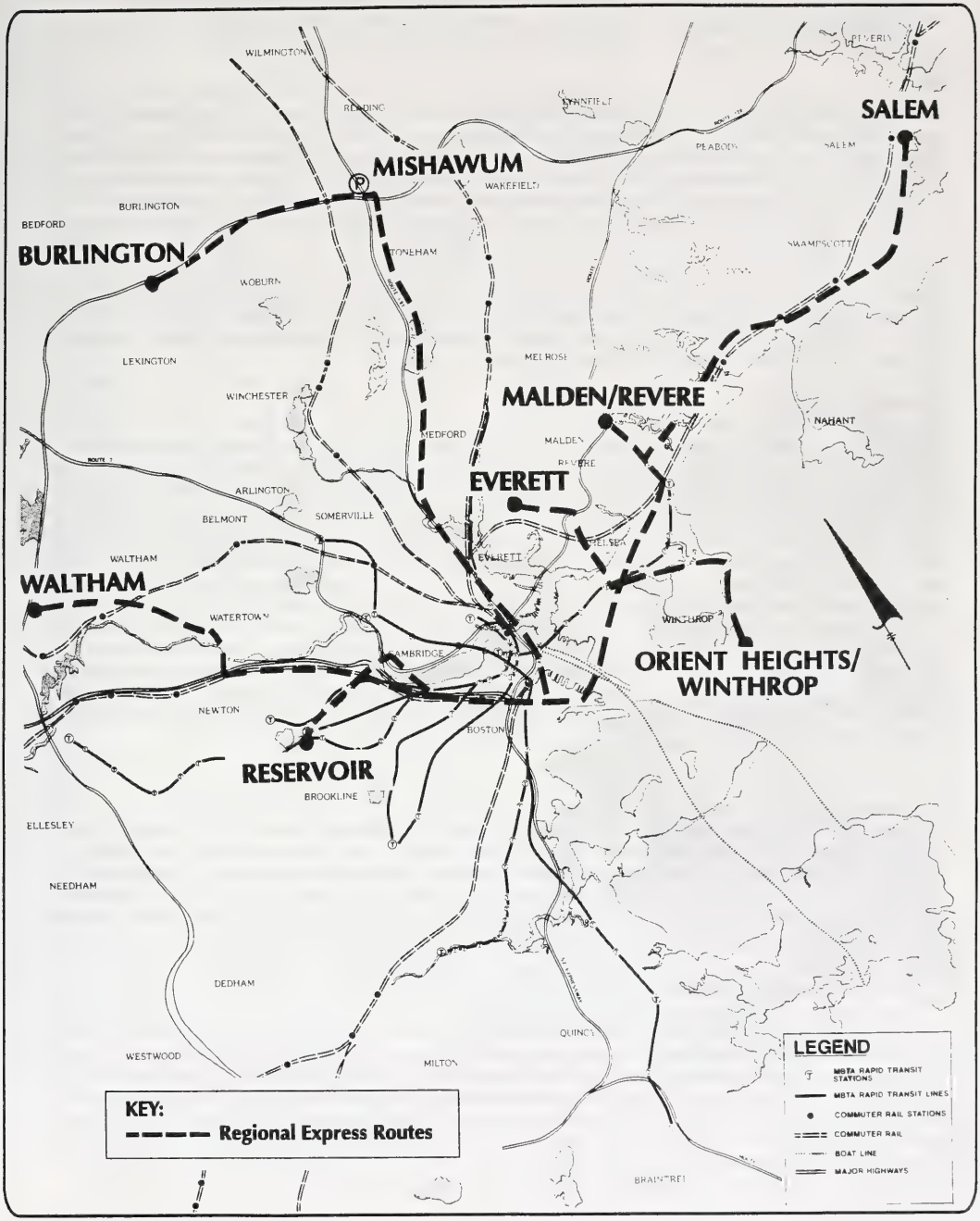
Fig. 2-6
Bus/TSM Alternative
Express Bus Service



North Corridor express buses (from Mishawum and Burlington) would leave I-93 and enter the Piers area via the New Northern Avenue bridge. Buses would travel along New Northern Avenue to D Street, New Congress Street, and West Service Road before returning to New Northern Avenue and I-93. Stops would be restricted to major activity areas such as the Fan Pier, World Trade Center, and Congress Street/western Piers area.

West Corridor express buses would operate to the Piers area from Allston/Reservoir and Watertown/Waltham along I-90 (Massachusetts Turnpike) and the Seaport Access Road. Express buses from the West Corridor would exit the eastbound Seaport Access Road and enter the Piers area at West Service Road and Congress Street. These buses would circulate through the Piers area via West Service Road, New Northern Avenue, and East Service Road. New Congress and C Streets would be used to return to the westbound Seaport Access Road ramp. Like the other express services operating to the Piers area, stops would be limited; West Corridor buses are planned to stop only on West and East Service Roads.

The routings and stops proposed for the various express buses could be easily modified in order to provide access to additional activity centers. Most express buses would only be able to provide one peak hour trip per bus. However, should demand warrant, additional stops for passenger discharge and boarding could be made at locations such as BMIP without affecting schedules.

Operating Speeds

In the Bus/TSM Alternative, bus operating speeds are assumed to vary with the operating environment for each type of service. In the Piers area, buses operating in mixed traffic are assumed to travel at 6 miles per hour. However, the exclusive bus lane on New Congress Street would offer a higher level of service — 10 miles per hour — due to its pullout lanes and restrictions on usage by other vehicles. Likewise, in residential and industrial South Boston, lower levels of congestion are assumed to allow buses to operate at 10 miles per hour as well. Since lower density development in the vicinity of BMIP would result in low levels of congestion, buses could operate at 12 miles per hour. On Seaport Access Road ramps, buses are assumed to operate at 20 miles per hour.

Outside of the Piers area, buses serving the area would operate at speeds that generally reflect roadway and traffic conditions presently experienced by MBTA services. Express buses would operate at highway speeds on I-90 and I-93. Local and shuttle buses would operate at slower speeds characteristic of mixed traffic in the more congested downtown area. Speed assumptions for areas outside of the Piers area have already been developed for regional travel demand forecasting models.

2.3.2.2 Fare Collection Methods

Fare collection methods would be the same as for other MBTA surface bus routes. Fare collection would be by means of payment of a cash fare or token when boarding the bus, or use of a monthly pass. Current MBTA fare policies are assumed to remain in effect, including free transfers between rapid transit lines and no free transfers to surface bus routes. No special fare policies or payment plans are anticipated for service proposed in the Bus/TSM Alternative, nor would fares differ by time of day, consistent with current MBTA fare policy.

2.3.2.3 Capital Requirements

Capital requirements in the Bus/TSM Alternative would include procurement of vehicles, construction of a storage and maintenance facility for those vehicles, construction of a bus lane on New Congress Street (in the high growth scenario only), and provision of passenger amenities. Due to the large volumes of passengers traveling by bus under this alternative, adequate passenger handling facilities must be provided in the Piers and downtown areas. In the Piers area, two modest surface facilities would be constructed, one at Fan Pier, which is anticipated to handle 1,200 to 1,400 peak hour boardings, and the other at World Trade Center, handling 1,500 to 1,900 peak hour boardings. Each facility would be handicapped accessible and equipped with a waiting area, restrooms, and a change and information booth to speed

passenger boardings. Bus pullout areas would be constructed at each of these facilities, in addition to locations along Northern Avenue and West Service Road. Shelters, benches, and lighting would be provided at other stops in the Piers area. In the downtown area, an unmanned, partially enclosed surface facility would be constructed on Oak Street adjacent to the Don Bosco High School. A three-berth bus pullout would be provided at this location to facilitate passenger waiting/loading activities and bus operations.

Vehicle Requirements

The Bus/TSM Alternative would require a mix of standard and articulated buses. As noted earlier, the articulated buses would be used on Route 7 in addition to some of the high volume shuttle routes linking rapid transit stations with the Piers area. Standard buses would be used on the remaining local and shuttle routes, as well as on the express routes. Based on ridership estimates and resulting headways ***and refinement of the operating plan***, it is anticipated that ***35*** articulated and ***100*** standard buses would be required to operate the high growth scenario service in the Bus/TSM Alternative. The lower growth vehicle requirements would be ***74*** standard buses; no articulated buses would be required. ***These numbers assume a spare ratio of 20 percent for articulated buses and 15 percent for standard buses.*** Consistent with MBTA policy, all vehicles would be fully accessible to persons with disabilities.

Storage and Maintenance Facility

An additional facility would be needed to store and maintain the vehicles in the Bus/TSM Alternative. ***Based on screening conducted since publication of the DEIS/SDEIR, two sites located on a 58-acre parcel managed by the Massachusetts Port Authority's (Massport) Maritime Department and bounded by Summer/Fargo Streets, Pappas Way, West First Street, and E Street are under consideration for a storage and maintenance facility. As shown in Figure 2-7, Site A is located in the northwestern portion of this parcel on the corner of Summer Street and Pappas Way, while Site B is located on West First Street at the southern end between E Street and Pappas Way.***

The advantages of these sites are threefold. First, both sites can be accessed without recourse to local residential streets ***(from Summer Street in the case of Site A, and from West First or E Streets in the case of Site B)***. Second, both sites are surrounded by reasonably compatible uses and are relatively free of structures, thus minimizing potential site development costs. Third, both sites are of appropriate configuration, are well served by utilities, and are compatibly zoned. Either site could accommodate the vehicle fleets contemplated for either the high or lower growth scenarios.

Bus Lane

Bus lanes are generally warranted in those locations where volumes exceed approximately 60 buses per hour. While bus patterns were dispersed as much as practicable in order to minimize the need for bus lanes, such volumes occur along New Congress Street in the westbound direction in the high growth scenario. As a consequence, approximately 1,600 feet of bus lane would be required on New Congress Street between D Street and West Service Road to expedite bus flows in this alternative. In discussions with the Boston Transportation Department, it has been determined that it would not be possible to remove a parking lane to serve as a bus lane during peak hours. Therefore, the bus lane would be added to the travel lanes currently designed for New Congress Street and would occupy the curb lane. Since it would be necessary to preserve on-street parking, displaced curb lane parking would be moved to the median side of New Congress Street westbound. For safety considerations, this area may be designed with angle parking rather than parallel parking. As a result, partial property takings would be necessary to widen the street right-of-way to accommodate the bus lane and the reconfigured on-street parking. Figure 2-8 shows the proposed New Congress Street bus lane. As noted previously, a bus lane is not necessary in the lower growth scenario; ***however, right-of-way would be purchased in the lower growth scenario to preserve the option for a future bus lane if demand and service increases.***

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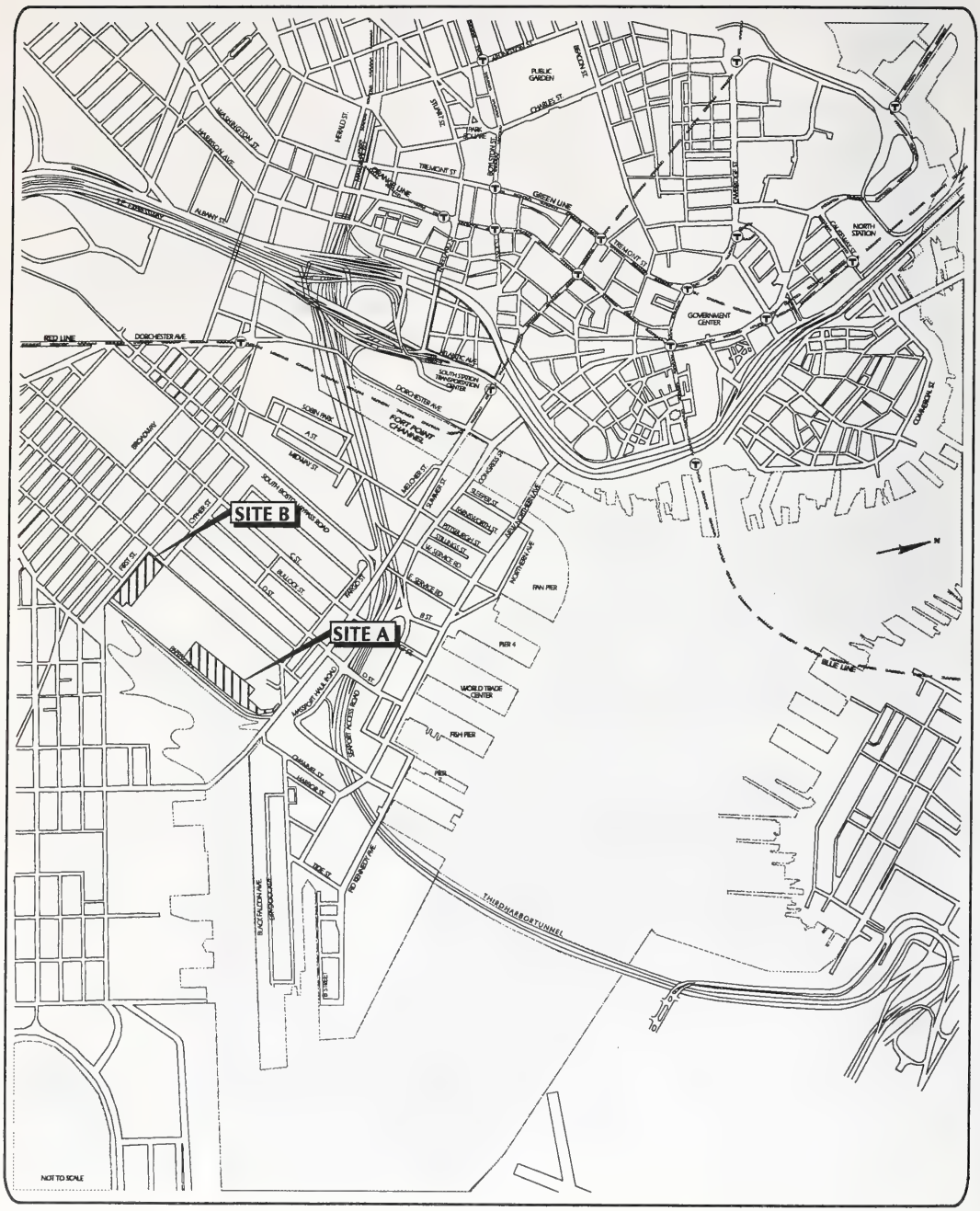
South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-7
Sites Considered for Maintenance Facility



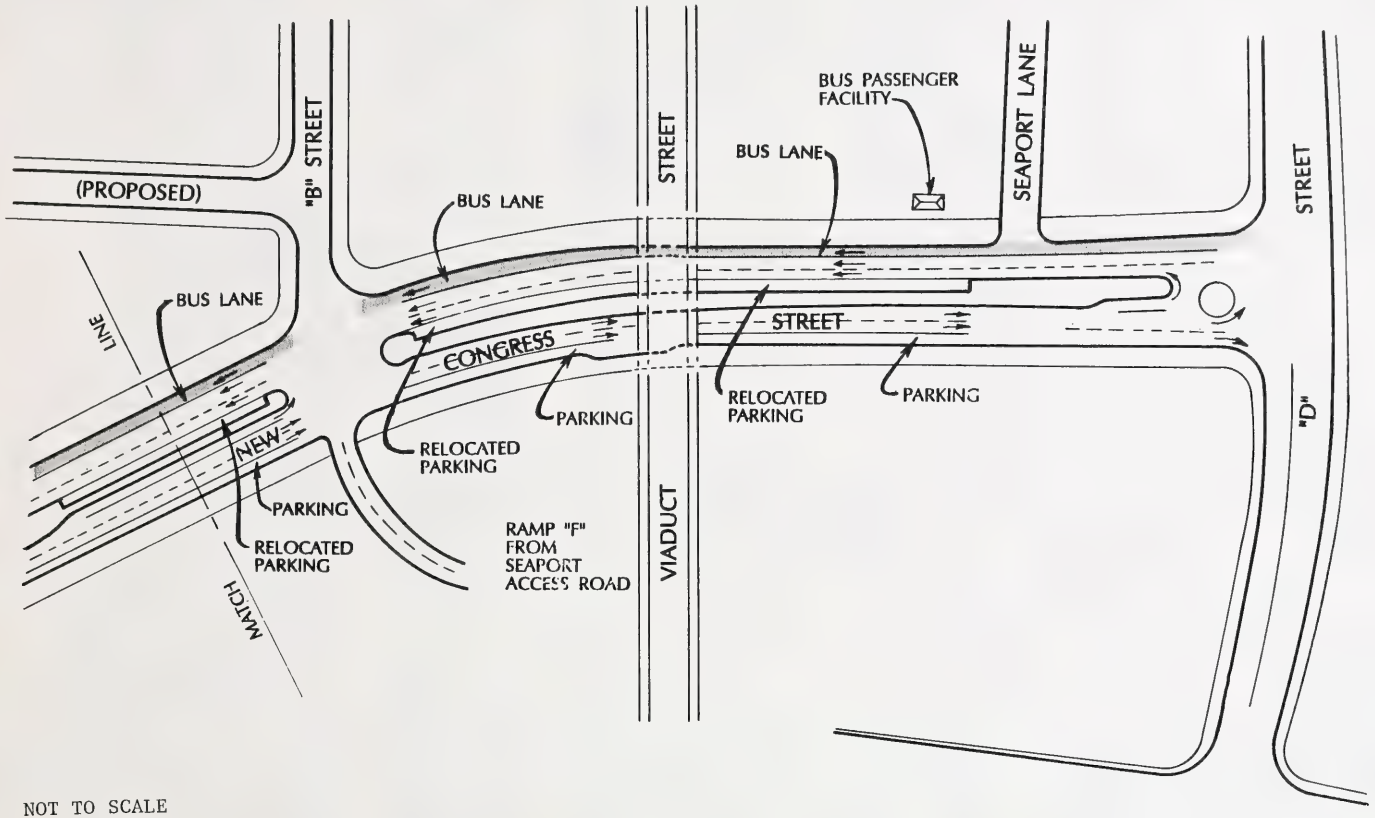


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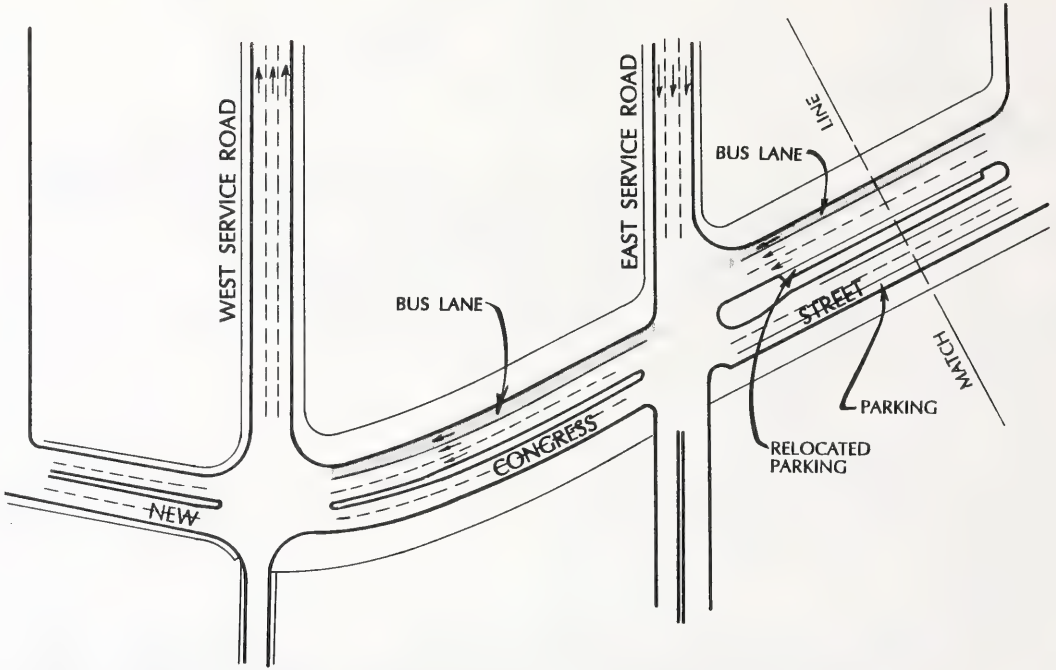
Fig. 2-8, 1 of 2
Bus/TSM Alternative - New Congress Street Bus Lane (High Growth Scenario)



NOT TO SCALE

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South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-8, 2 of 2
Bus/TSM Alternative - New Congress Street Bus Lane (High Growth Scenario)

Passenger and Bus Pullout Facilities

In order to circulate buses efficiently throughout the project area, a limited number of stops would be made. As a consequence, in both the high and lower growth scenarios, large numbers of passengers would be boarding at relatively few stops. To ensure the safety and comfort of waiting passengers, amenities such as shelters, benches, and lighting would need to be provided at most of the stops in the Piers and downtown areas. In addition, three passenger facilities, each encompassing an area of approximately 9,000 square feet, would be constructed at high volume locations in the vicinity of Fan Pier, World Trade Center, and Oak Street. The Fan Pier and World Trade Center facilities (serving up to 1,500 and 1,900 peak hour passengers, respectively) would consist of a closed structure providing waiting space, a manned token booth, and restrooms. Both facilities would be handicapped accessible. The Oak Street facility in downtown would consist of a partially enclosed, unmanned structure.

To facilitate bus movements, bus pullout berths would be desirable at some stop locations. For example, buses would operate at volumes of up to 60 per hour along New Congress Street. To prevent stopped buses from obstructing other buses operating along the street, a two-berth bus pullout area 15 feet wide by 230 feet long would be placed at C and New Congress Streets in front of the passenger facility. A pullout area at this location would assist in maintaining an efficient flow of buses through the bus lane. Right-of-way for this pullout area would be acquired from the development parcel bordered by New Congress Street between C and D Streets.

Elsewhere in the Piers area, two additional bus pullout areas would aid general traffic flow along West Service Road and Northern Avenue. A five-berth pullout area 425 feet in length would serve five routes and peak hour westbound volumes of 53 buses at New Northern Avenue in the vicinity of Fan Pier. This pullout would also serve as a layover area for the Copley to West Piers and the New England Medical Center to West Piers routes. A passenger facility would be constructed at this location to accommodate anticipated high volumes of riders using the five routes that stop at Fan Pier. A second single-berth pullout would be located on East Service Road near the intersection with New Congress Street. This pullout would generally serve express buses via the Third Harbor Tunnel and I-90. Right-of-way for these two pullout areas would be acquired by removing curbside parking. Passenger shelters would be placed at additional locations in the Piers area to protect waiting passengers from the elements.

In the downtown area, a three-berth bus pullout would be placed at the Oak Street passenger facility. A bus pullout at this location is needed to accommodate the relatively large number of boarding and alighting passengers, many of whom would be connecting with the New England Medical Center Orange Line Station. The 230-foot pullout lane would be necessary in order to prevent curbside bus loading from interfering with traffic on Oak Street. Construction of the pullout lane would result in the relocation of the public sidewalk abutting a walkway area used by the Don Bosco High School. No structures or fixed facilities would be affected by construction of this lane.

2.3.3 Fort Point Channel Underground Transitway Alternatives

The Fort Point Channel Underground Transitway Alternatives represent a fixed guideway solution to linking areas of new development in the South Boston Piers area with regional mass transit services in downtown Boston. An underground transit tunnel connects existing MBTA services and critical development centers in the Piers area, while the use of bus technology offers operational flexibility needed to meet evolving demand. Transitway service would be operated with trackless trolleys that are electrically powered via catenary both in the tunnel and on surface streets.

The decision to operate trackless trolleys reflects additional analysis performed since publication of the DEIS/SDEIR. In the DEIS/SDEIR, two technology options were considered: trackless trolleys and dual mode buses. Like trackless trolleys, dual mode buses would use electric power in the Transitway tunnel; however, on surface streets, dual mode buses would switch to diesel (or an alternative fuel) power. Dual mode buses are currently operated in revenue service in only one U.S. location — Seattle, Washington. The chief advantage of the dual mode bus technology is flexibility

of operation since overhead catenary is not needed for power on surface streets. However, disadvantages could include operational deficiencies, a long and complicated procurement process, concerns about the safe transport of alternative fuel in tunnel, and the lack of experienced operators and maintenance personnel. Given these disadvantages, the MBTA has selected trackless trolleys as the Transitway vehicle technology. In the Boston metropolitan area, the MBTA has proven the reliability and safety of trackless trolley technology. Furthermore, trackless trolleys contribute to the attainment of air quality standards mandated by the Clean Air Act Amendments.

2.3.3.1 Termini Alternatives Under Consideration

As shown in Figure 2-9, three termini alternatives have been considered for the Underground Transitway: a Full Build Alternative and two Minimum Operable Segment (MOS) Alternatives. The figure shows only the tunnel segment associated with each termini alternative; surface routes are shown later in this section.

Under the Full Build Alternative, the Transitway tunnel would extend from Boylston Station in the west to the World Trade Center in the Piers area. The two MOS Alternatives represent shorter versions of the project that could be implemented on an incremental basis. In both MOS Alternatives, the Underground Transitway tunnel would begin in the west at South Station and extend to either Fan Pier/Courthouse in the western Piers area (MOS-1) or to World Trade Center (MOS-2). Tunnel construction in either MOS option would be designed to accommodate later extension of the Transitway tunnel to the full build limits.

In all termini alternatives, service would be provided at surface between the Transitway tunnel portal and BMIP and Summer Street. The portal would be located at Fan Pier/Courthouse in the MOS-1 Alternative and at the World Trade Center in the MOS-2 and Full Build Alternatives. A maintenance and storage facility would be constructed at one of the two sites identified in Section 2.3.2.3.

2.3.3.2 Underground Transitway Alignment

MOS-1 Alternative

The alignment of the MOS-1 Alternative would begin at a new Transitway station constructed at the present mezzanine level of South Station to allow transfer connections with the Red Line and commuter and intercity rail and bus services. An underground bus loop extending beneath Atlantic Avenue would permit turnaround of Transitway vehicles at South Station. The Transitway tunnel would be located above the Red Line tunnel at South Station.

From South Station, the alignment would continue north under Atlantic Avenue ***to Congress Street. At Congress Street, the alignment would turn east under the Russia Wharf buildings.*** Joint construction would be undertaken with the northbound Central Artery between Essex and Congress Streets (see Figure 2-9) in order to achieve substantial costs savings and to avoid the impacts created by two separate construction efforts; the Transitway tunnel would be constructed directly above the northbound Central Artery along Atlantic Avenue. A typical section of this joint construction segment is shown in Figure 2-10. East of Russia Wharf, the alignment would cross under the Fort Point Channel south of the proposed New Northern Avenue bridge.

The MOS-1 alignment would come to surface in the vicinity of Fan Pier and the new Federal Courthouse at a portal between Pittsburgh and Farnsworth Streets; a surface station would be constructed at this location. This portal would be constructed in a manner that would not preclude future extension of the Transitway tunnel to the World Trade Center. Transitway vehicles would operate via surface streets throughout the Piers area to BMIP and Summer Street from this portal location.

An on-street stop would be provided at World Trade Center. Intermediate activity centers between the portal and BMIP or Summer Street would also be served by on-street stops.

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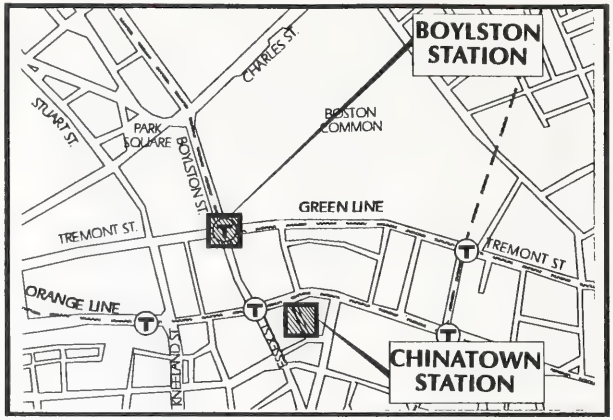
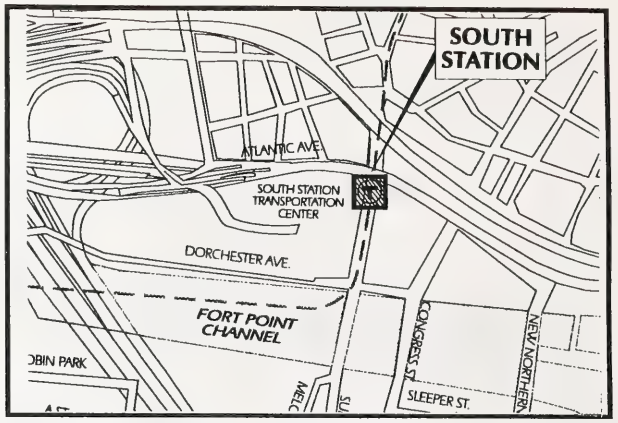
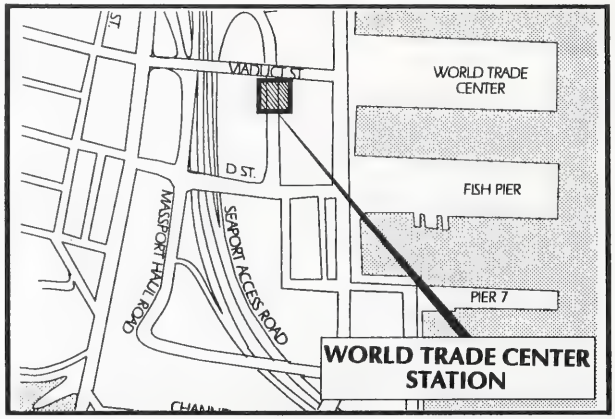
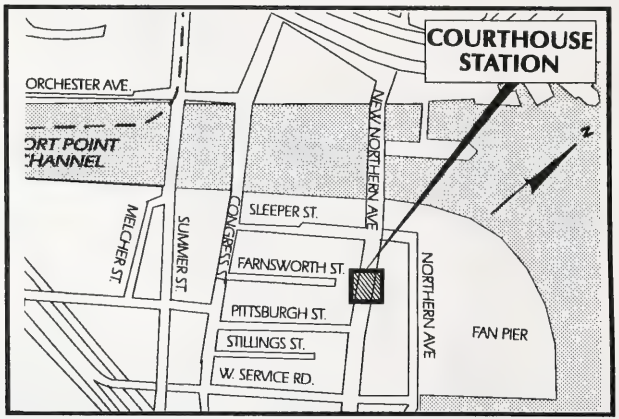
Figure 2-9, 1 of 2
Underground Transitway Alternatives









KEY:
Ⓣ EXISTING TRANSIT STATION
PROPOSED TRANSITWAY STATION

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Fig. 2-9, 2 of 2
Station Locations
Underground Transitway Alternatives

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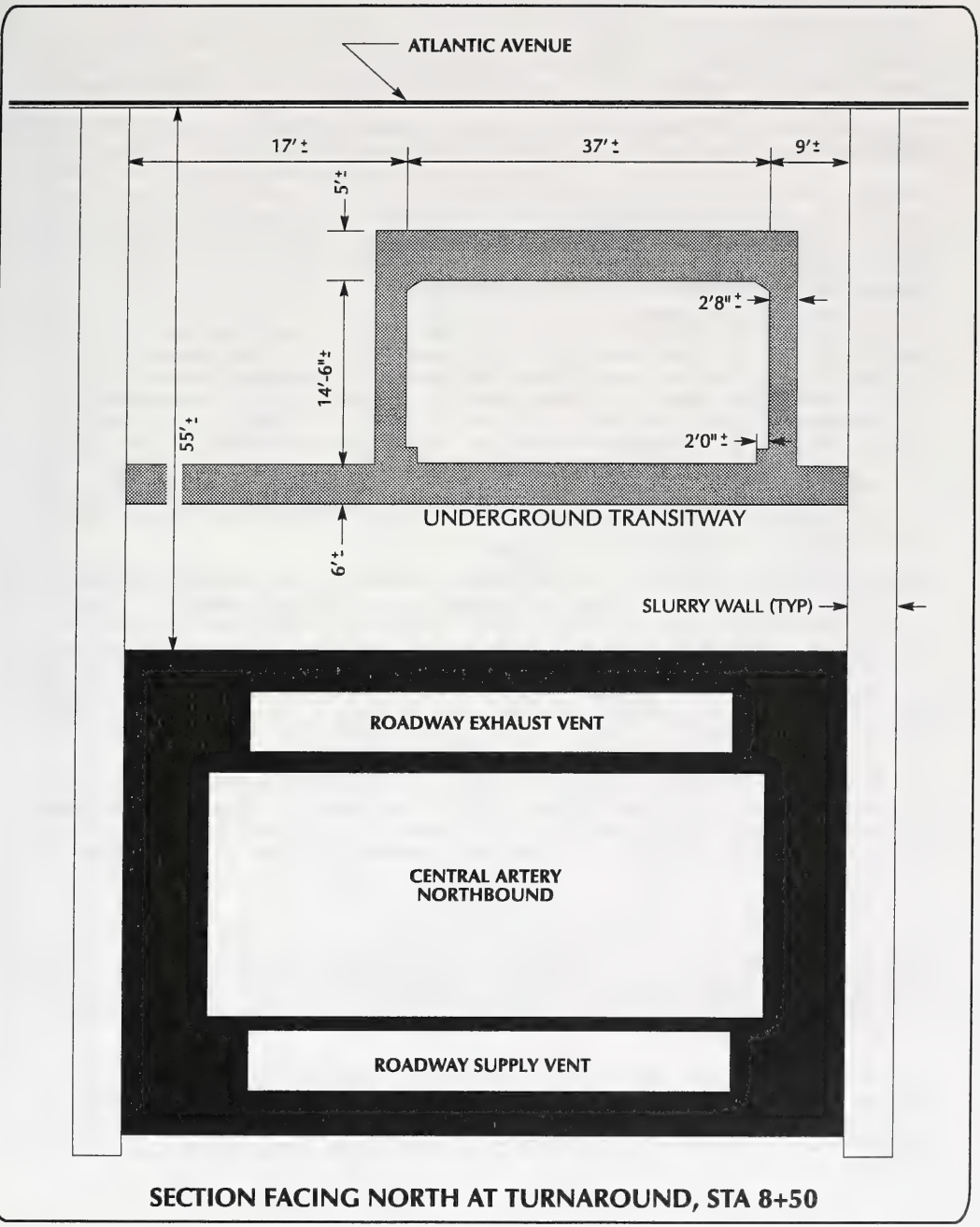
South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-10
Underground Transitway Over Northbound Central Artery



SECTION FACING NORTH AT TURNAROUND, STA 8+50

On the surface portion of Transitway routes, accessibility for persons with disabilities would be enabled by on-board lifts in a manner similar to current MBTA surface bus operations. All supplementary surface routes would be made accessible in the same manner.

To accommodate a future full build alignment, the MOS-1 Alternative would also include a stub-ended extension of the Transitway tunnel approximately 400 feet long constructed beneath Essex Street starting at the intersection of Atlantic Avenue. This would permit construction of a future extended alignment to occur without interfering with revenue service in the Atlantic Avenue Transitway tunnel.

MOS-2 Alternative

The alignment of the MOS-2 Alternative would be identical to the MOS-1 Alternative to the eastern edge of the Fort Point Channel. However, after crossing the Fort Point Channel, the MOS-2 alignment would remain underground to World Trade Center. An underground station — ***previously referred to as Fan Pier Station in the DEIS/SDEIR and now known as Courthouse Station*** — would be constructed in the vicinity of Fan Pier between Pittsburgh and Farnsworth Streets.

From Courthouse Station, the MOS-2 alignment would follow ***directly beneath New Northern Avenue until a point just west of East Service Road. At this point, the alignment turns southeast, cutting diagonally from New Northern Avenue to New Congress Street. An existing structure — the New England Seafood Cooperative — on the parcel between East Service Road and B Street would either be underpinned or taken. The decision to underpin or take the building requires additional coordination with MHD, Massport, the City of Boston, and owners of the Seafood Cooperative.***

At the MOS-2 tunnel alignment's eastern terminus, a underground station would be constructed in the lower level of the proposed Massport replacement parking garage just east of Viaduct Street. This station would be known as the World Trade Center Station.

East of World Trade Center Station, a less costly surface alignment is proposed. Surface operation would be feasible due to less intensive development planned for the eastern portion of the Piers area. Transitway buses would surface at D Street and operate to BMIP or Summer and Fargo Streets in mixed traffic. Transitway service to BMIP would operate via Northern Avenue and terminate on Drydock Avenue. After leaving the World Trade Center Station and surfacing in the Piers area, surface stops would be made at approximately 1,000 foot intervals, depending upon actual development patterns. Stops in the vicinity of BMIP would be at closer intervals, due to more concentrated development in that area. As in the MOS-1 Alternative, all vehicles would be accessible for persons with disabilities.

Also like the MOS-1 Alternative, a stub-ended extension of the Transitway tunnel beneath Essex Street beginning at the intersection with Atlantic Avenue would be constructed as part of the MOS-1 Alternative. This extension would permit later construction of the Transitway tunnel alignment to Boylston Station as part of the Full Build Alternative without disrupting service between South Station and the Piers area.

Full Build Alternative

The Full Build Alternative alignment would be identical to the alignment of the MOS-2 Alternative between South Station and the World Trade Center Station. In addition, the full build alignment would extend westward in tunnel to a connection at Boylston Station, as shown previously in Figure 2-9. A new platform and turnaround loop to serve the Transitway would be constructed one level below the existing Boylston Station Green Line platforms.

From Boylston Station, the Transitway alignment would turn east beneath Avery Street, with an underground station located in the vicinity of the intersection of Washington Street and Hayward Place. At that station, transfers could be made to the Chinatown Station of the Orange Line. The alignment would follow Avenue de Lafayette and Essex Street eastward, turning north under Atlantic Avenue to South Station.

Beginning at South Station, the Full Build Alternative follows the same alignment as the MOS-2 Alternative. Also like MOS-2, Full Build Transitway service would operate on surface streets east of the World Trade Center Station portal, using on-street bus stops between BMIP, Summer Street, and City Point. As in the MOS Alternatives, vehicles operating in the Full Build Alternative would be accessible for persons with disabilities through the use of on-board lifts.

2.3.3.3 Service Plan for the MOS Alternatives

The service plans for the two MOS Alternatives would be essentially the same. The only difference would be that the MOS-1 Alternative would use surface streets between Courthouse and the World Trade Center Stations, while the MOS-2 Alternative would remain in tunnel on that segment.

In the MOS-1 Alternative, service would exit the Transitway tunnel at the portal on New Northern Avenue near Fan Pier and the Federal Courthouse and travel east throughout the Piers area via B Street, New Congress Street, and D Street. In the MOS-2 Alternative, service would exit the Transitway tunnel at D Street. In both MOS Alternatives, two routes would be provided east of D Street; one route would travel south on D Street to Summer/Fargo Streets, while the second would operate via D Street and Northern Avenue to BMIP.

Table 2-5 shows the Transitway services in the two MOS Alternatives.

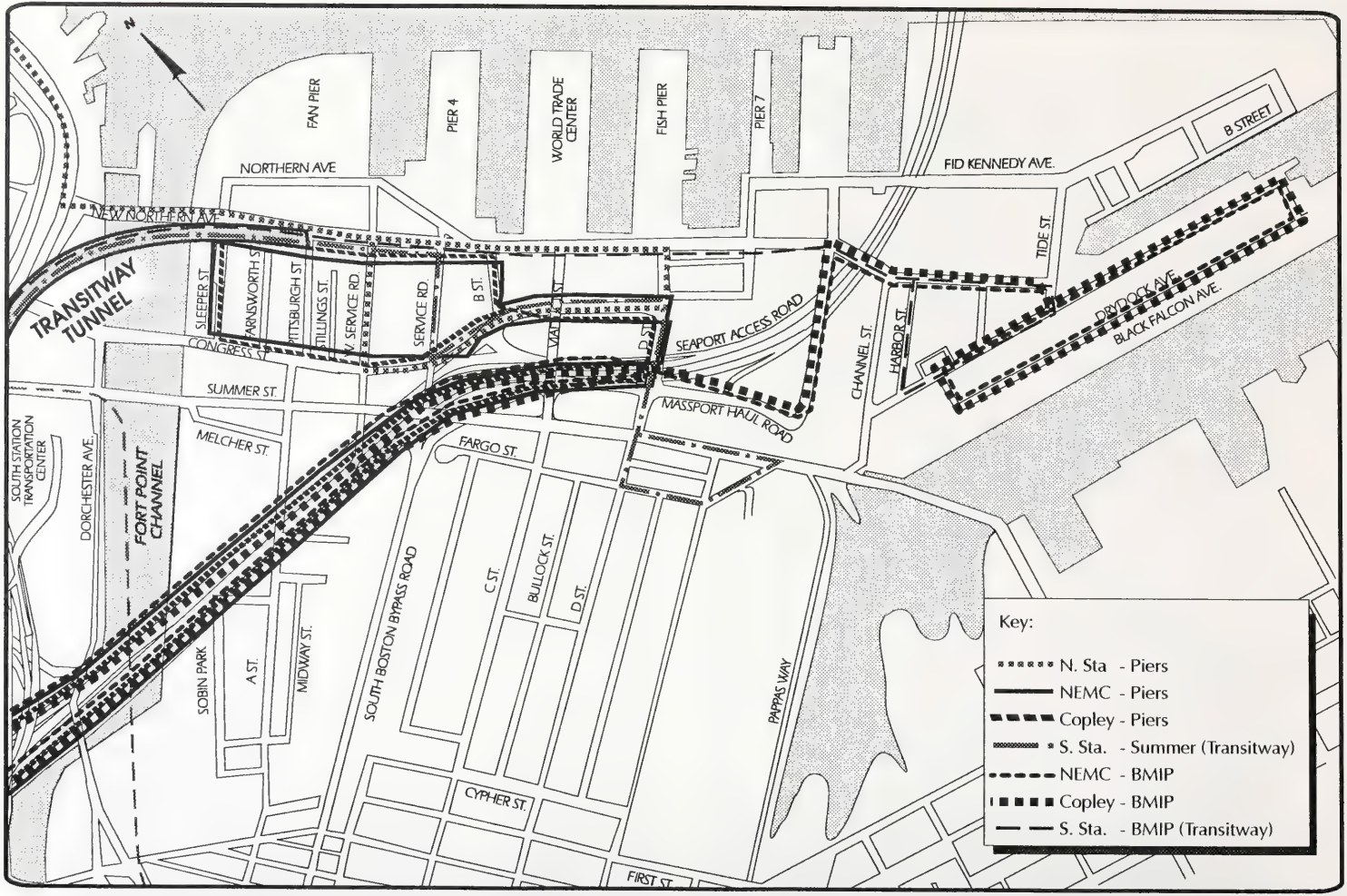
TABLE 2-5: OPERATING DETAILS: TRANSITWAY ROUTES (MOS ALTERNATIVES)

Route Description	Headway (minutes)	Buses Per Peak Hour	Peak Hour Capacity (Design)
Lower Growth Scenario			
South Station to BMIP	2.6	23	2,230
South Station to Summer/Fargo Streets	5	12	1,160
High Growth Scenario			
South Station to BMIP	1.6	37	3,590
South Station to Summer/Fargo Streets	3.5	17	1,650

Figure 2-11 depicts the MOS-1 Transitway and shuttle routes, while local and express routes are shown in Figure 2-12. MOS-2 Transitway and shuttle routes are shown in Figure 2-13, and local and express routes in Figure 2-14.

Operating Strategy for Transitway Routes

The MOS Alternatives would utilize different Transitway operating strategies for the lower growth and high growth scenarios. In the lower growth situation, the MOS Alternatives would provide a lower frequency of service than in the high growth scenario when development is anticipated to be greater.



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

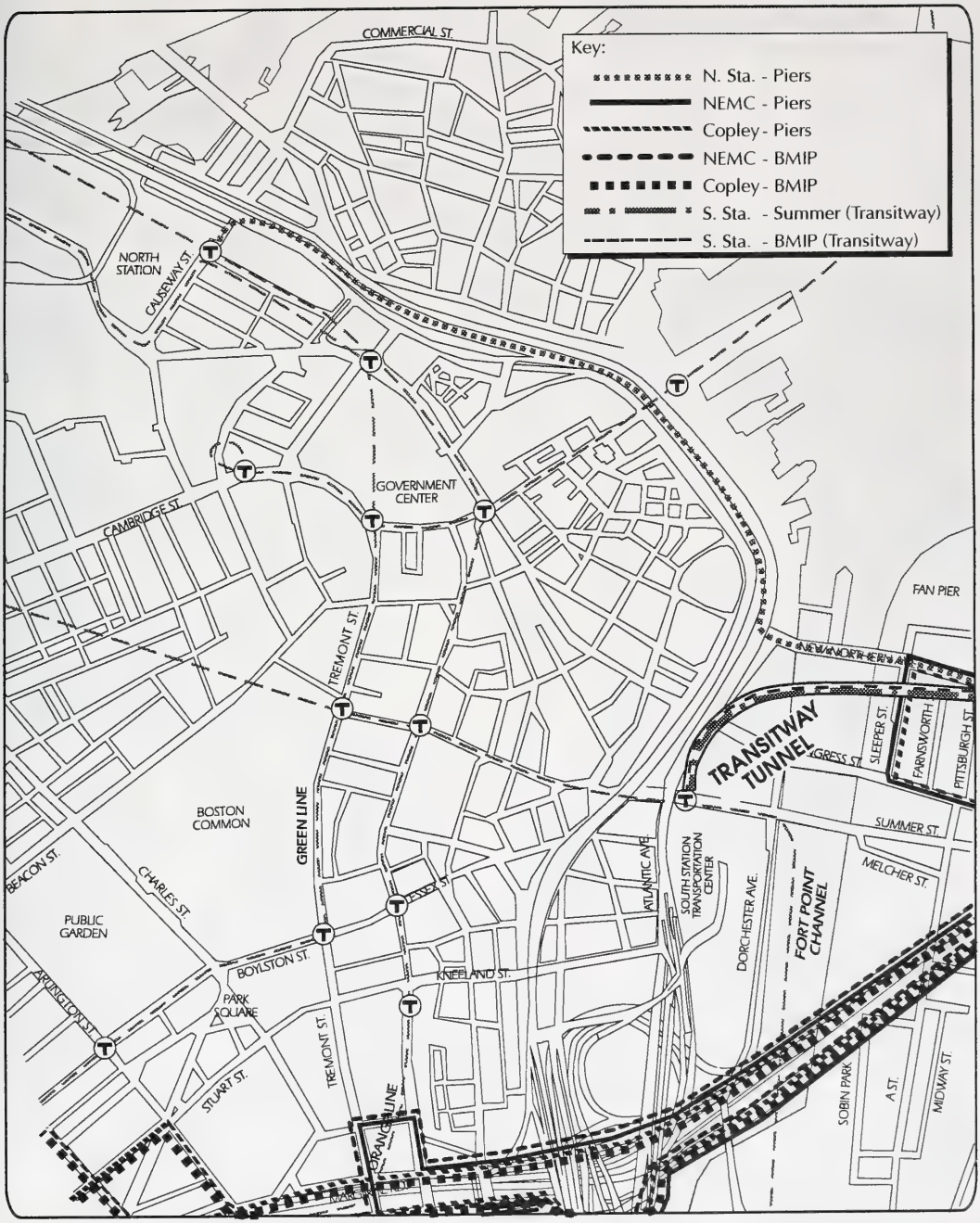
South Boston Piers/ Fort Point Channel Transit Project

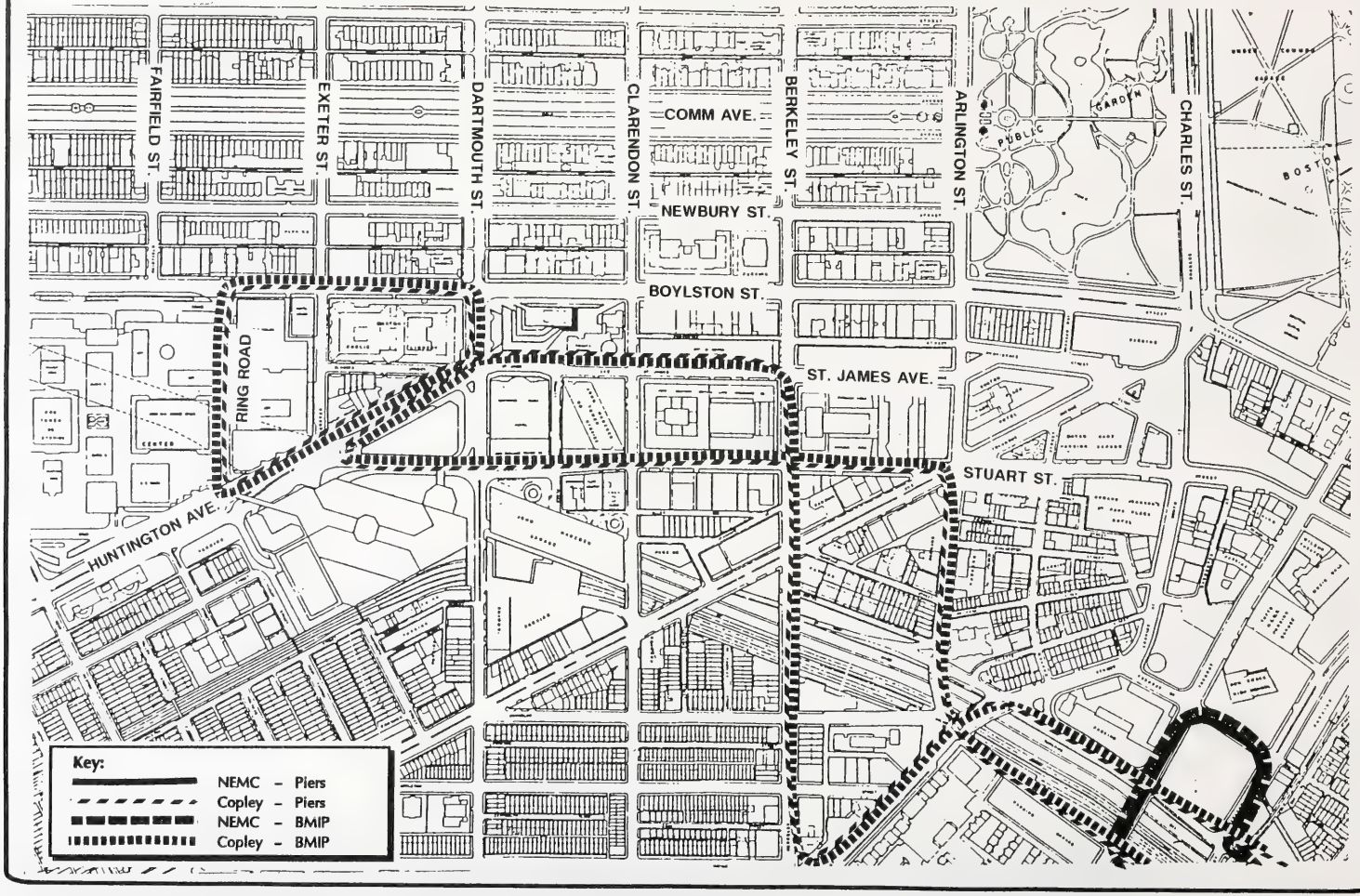
Fig. 2-11, 1 of 3
MOS-1 Alternative - Piers Area Shuttle and Transitway Routes

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-11, 2 of 3
MOS-1 Alternative
Downtown Area
Shuttle and Transitway
Routes

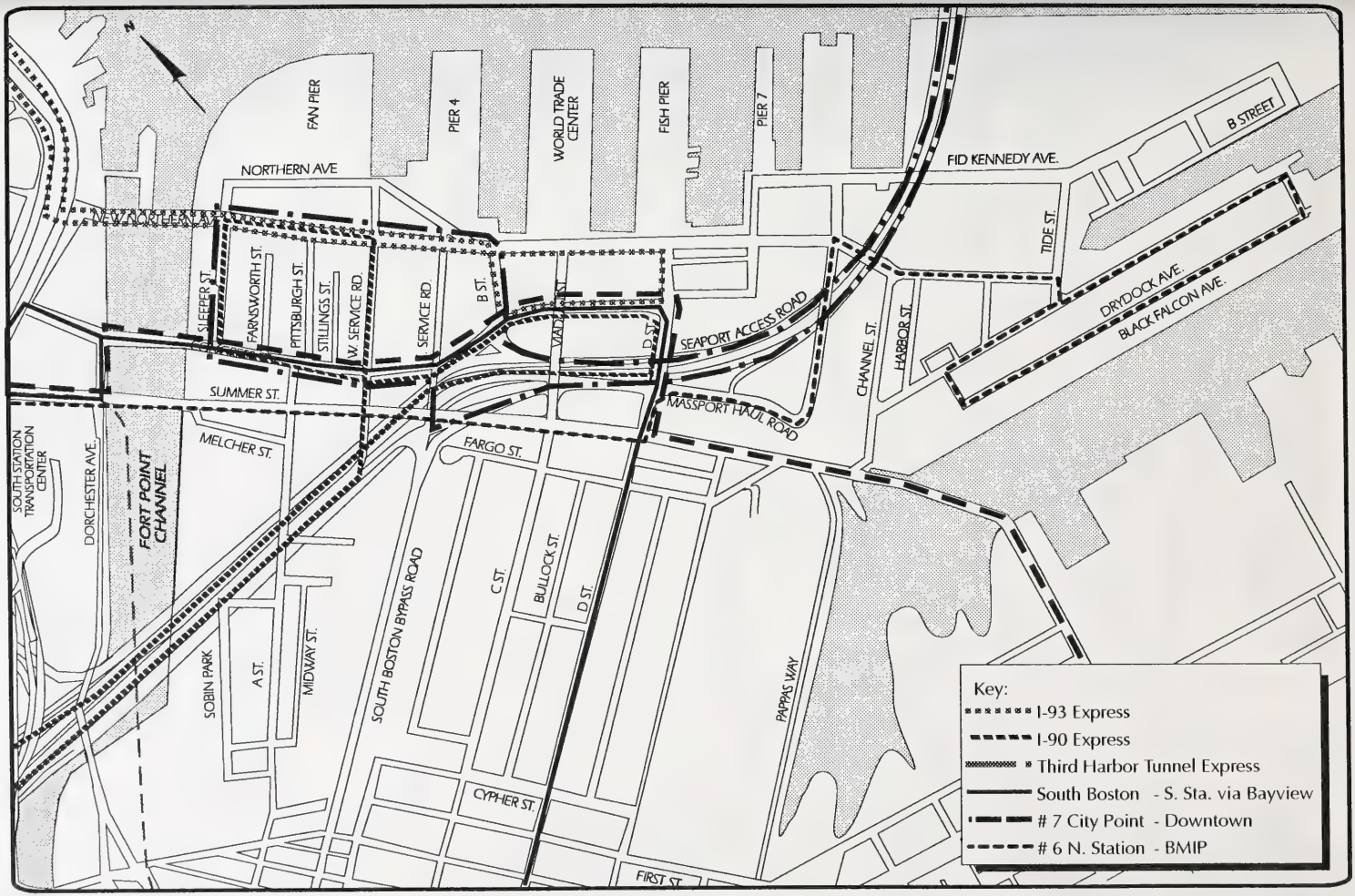




MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-11, 3 of 3
MOS-1 Alternative Back Bay - South End Area Shuttle and Transitway Routes



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

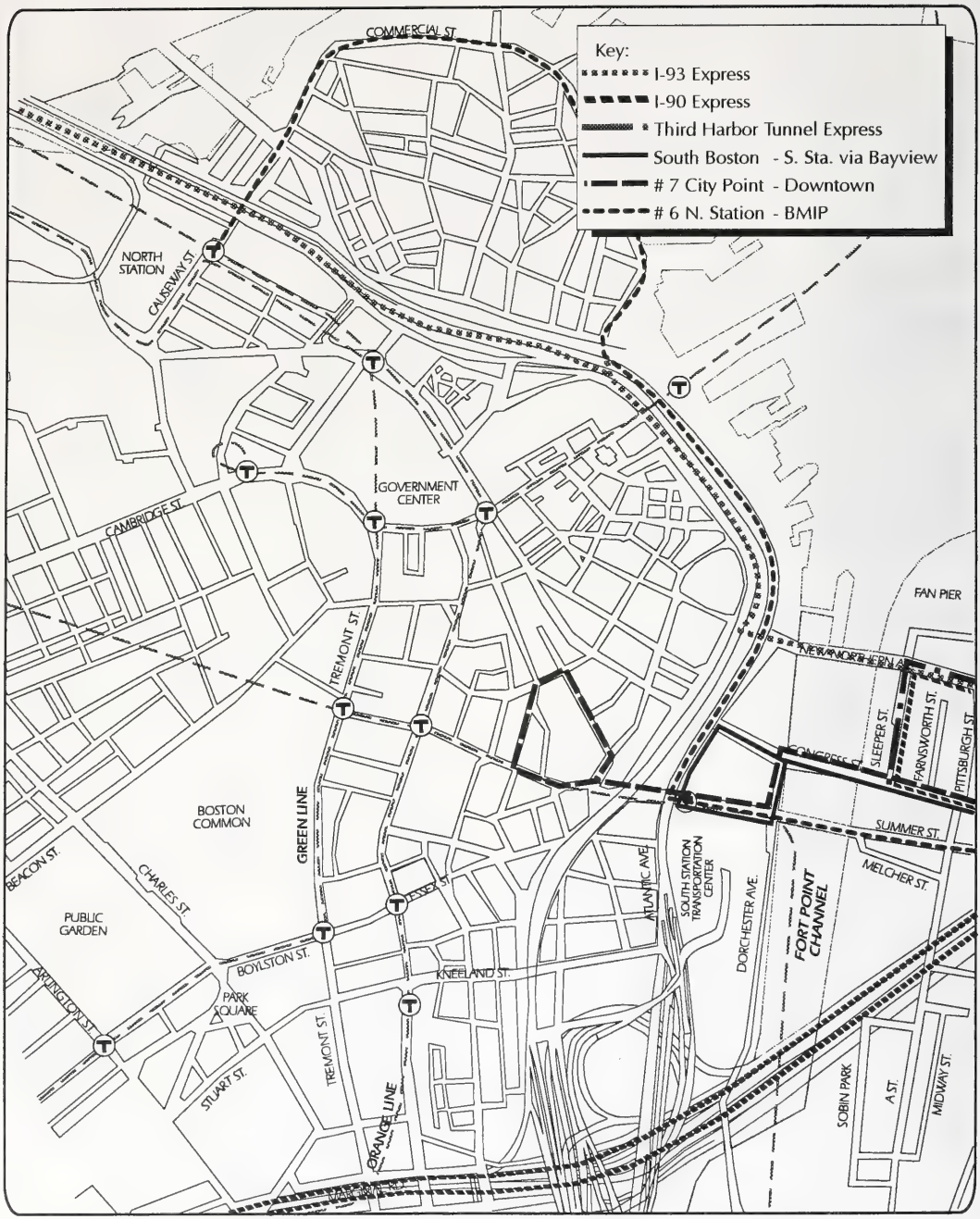
South Boston Piers/ Fort Point Channel Transit Project

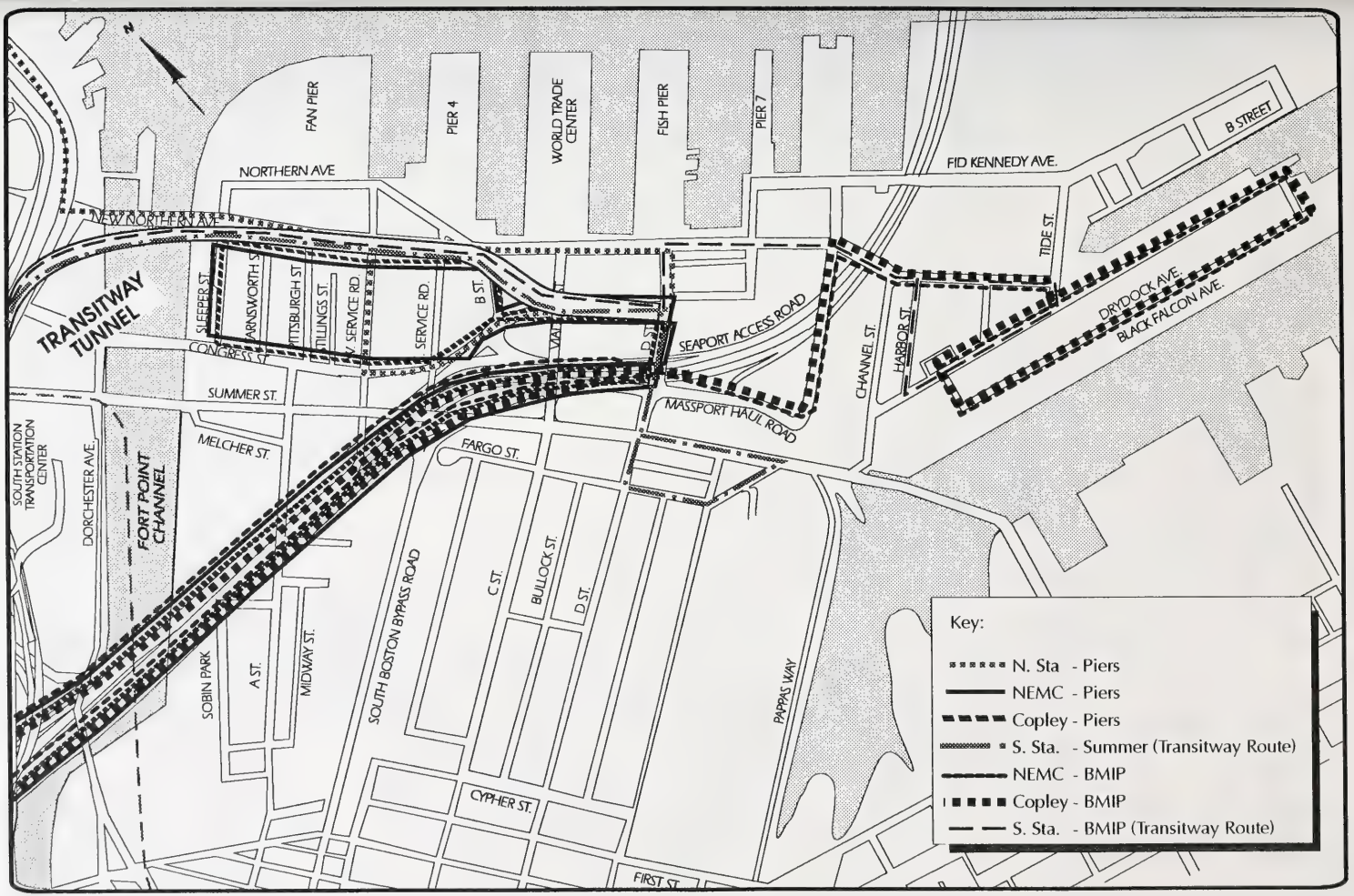
Fig. 2-12, 1 of 2
MOS-1 Alternative - Piers Area
Express and Local Routes

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fg. 2-12, 2 of 2
MOS-1 Alternative
Downtown Area
Express and Local
Routes





MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

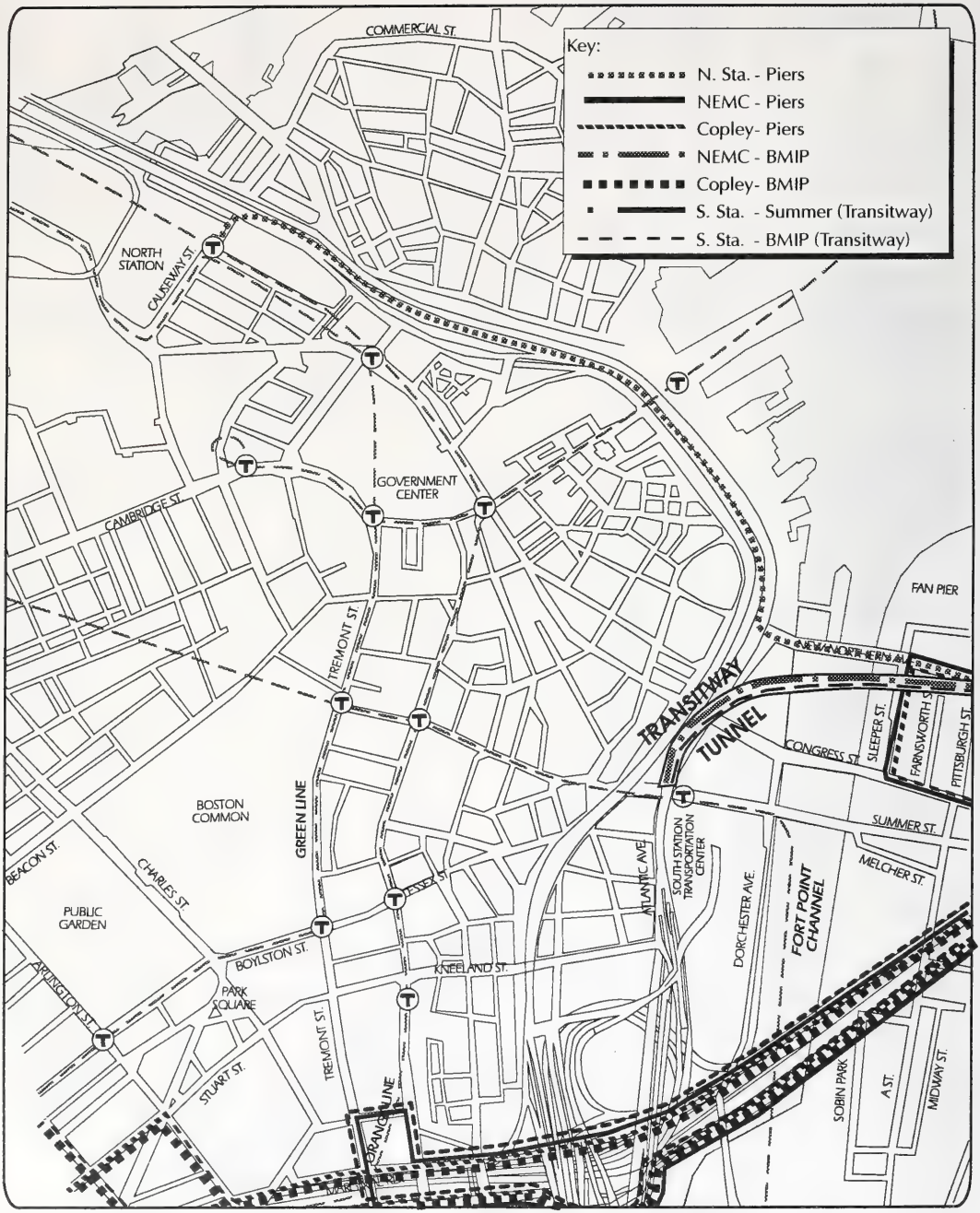
South Boston Piers/ Fort Point Channel Transit Project

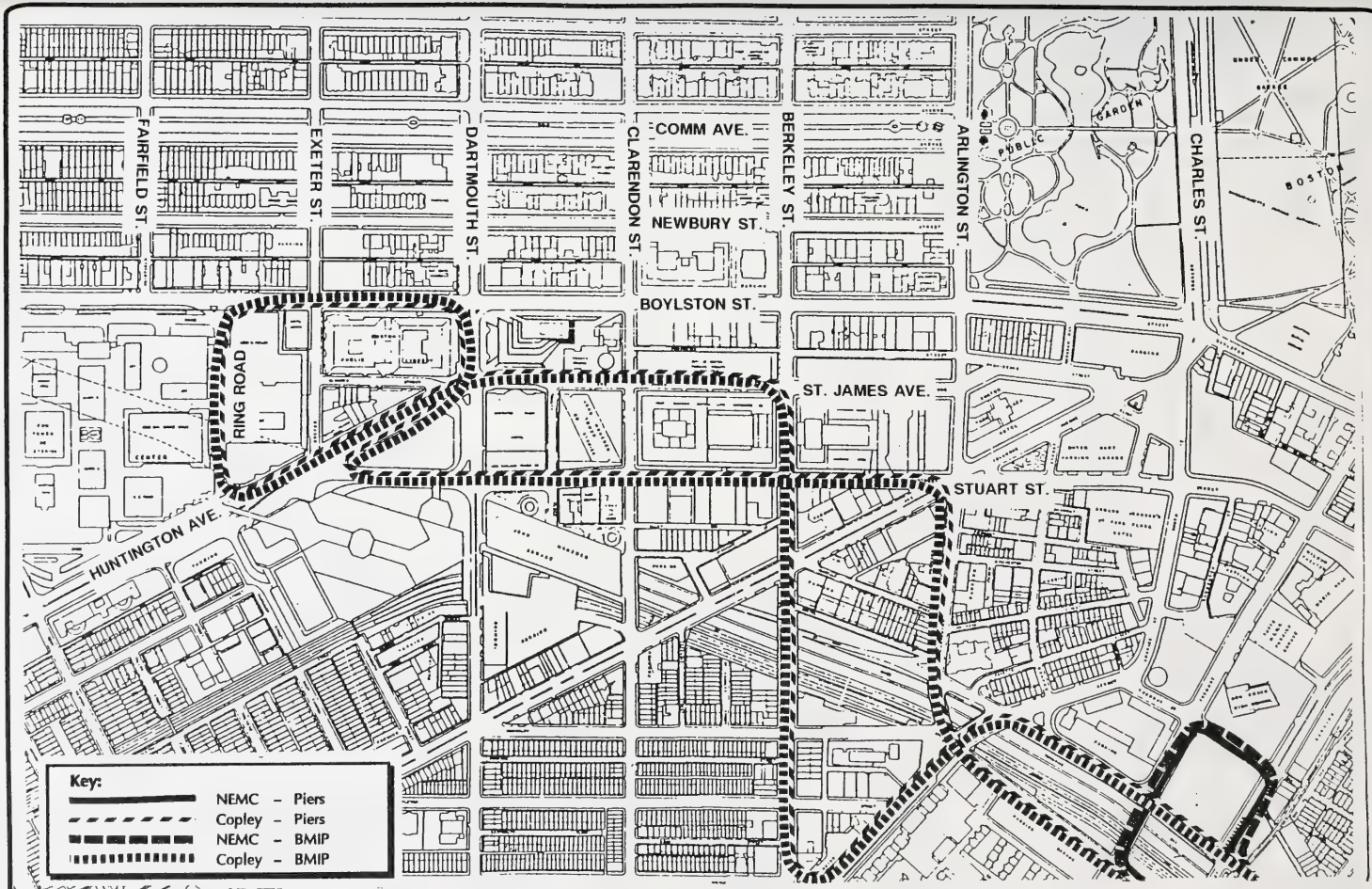
Fig. 2-13, 1 of 3
MOS-2 Alternative - Piers Area Shuttle and Transitway Routes

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-13, 2 of 3
MOS-2 Alternative
Downtown Area
Shuttle and Transitway
Routes

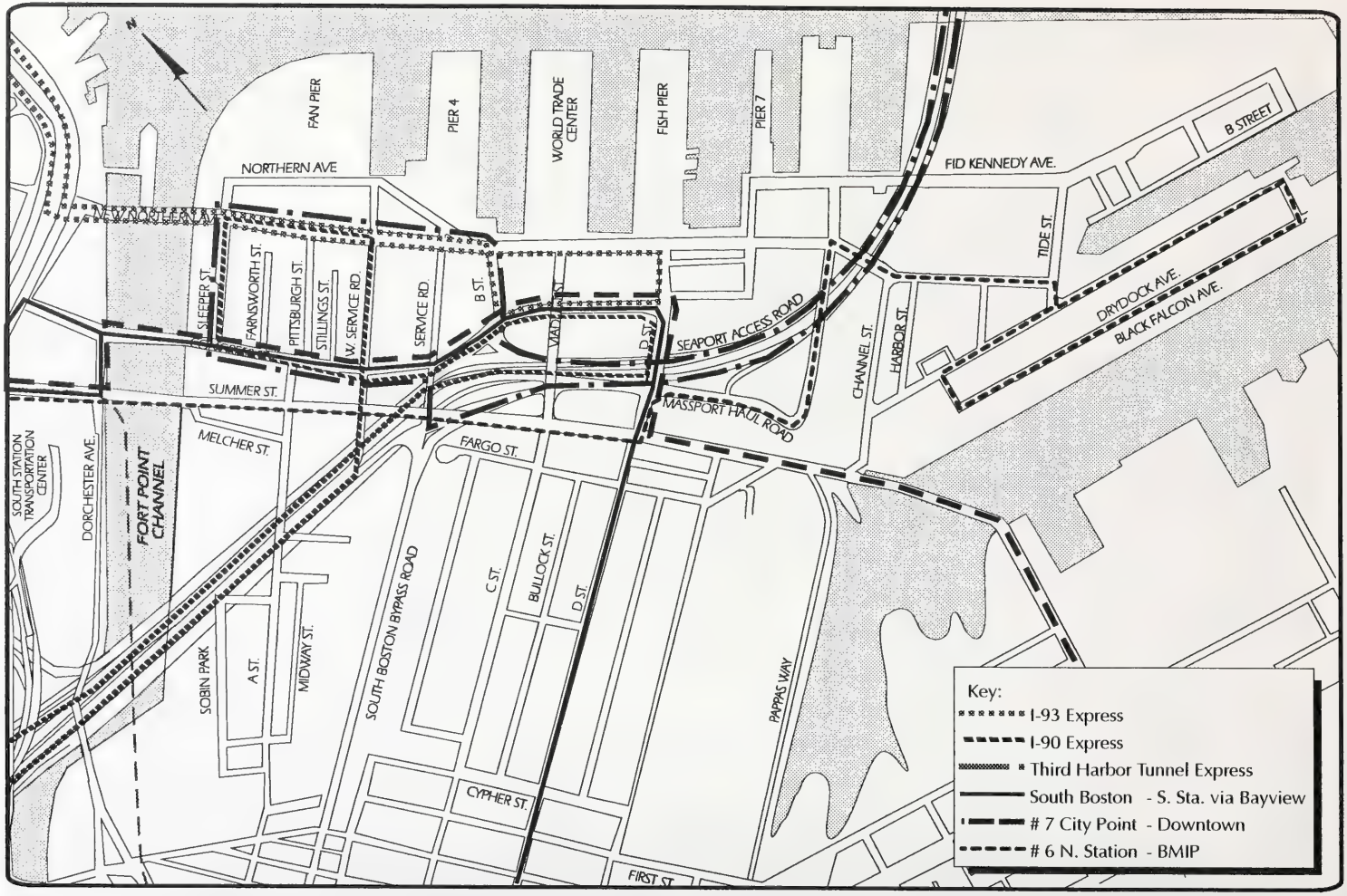




MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-13, 3 of 3
MOS-2 Alternative Back Bay - South End Area Shuttle and Transitway Routes



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

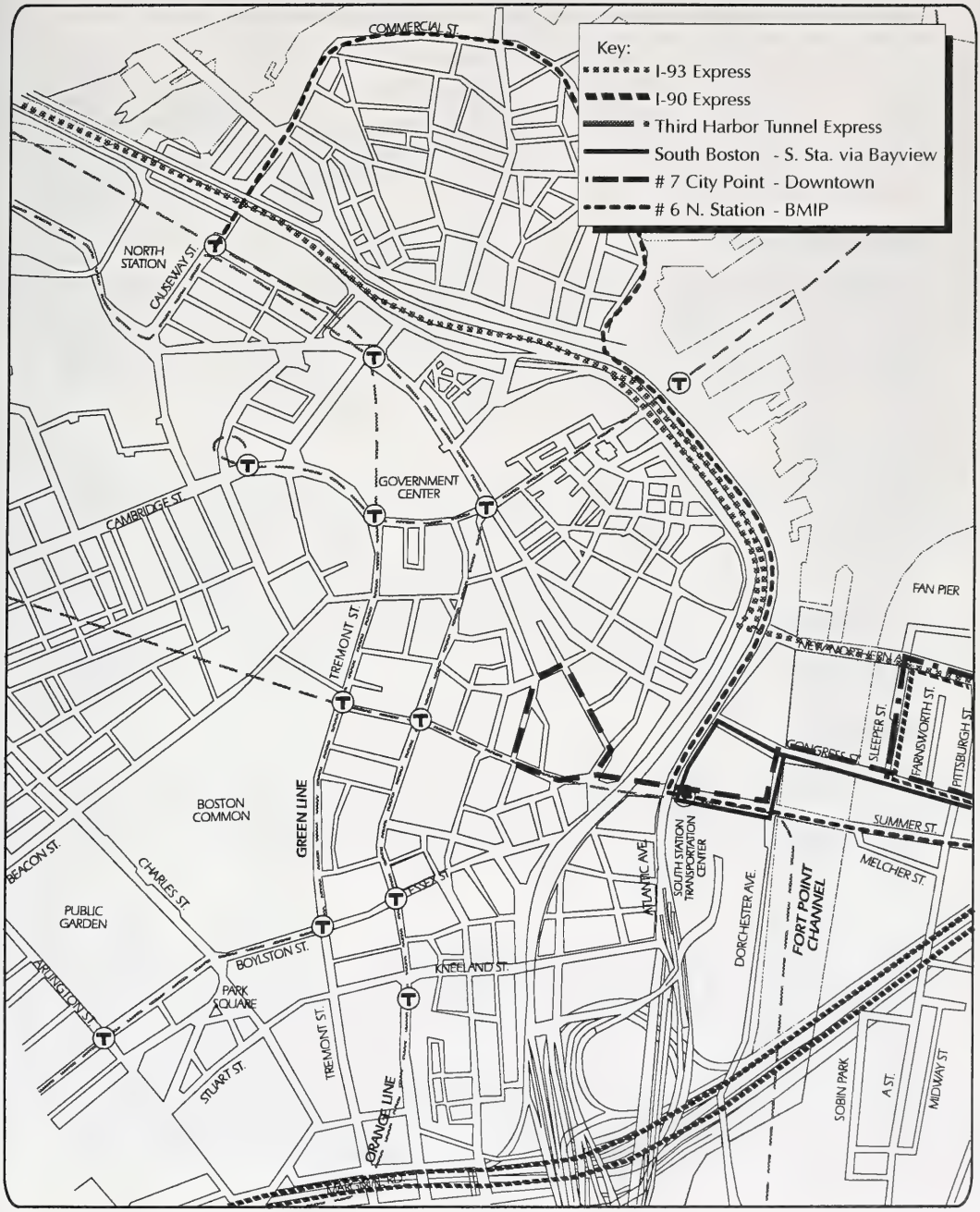
South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-14, 1 of 2
MOS-2 Alternative - Piers Area
Express and Local Routes

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fg. 2-14, 2 of 2
MOS-2 Alternative
Downtown Area
Express and Local
Routes



Lower Growth MOS Operating Strategy

Two routes would operate within the Transitway tunnel between South Station and the Piers area. One route would continue from the Transitway portal to BMIP at a 2.6-minute headway; the other would extend to Summer and Fargo Streets at a 5-minute headway.

High Growth MOS Operating Strategy

The same two routes would operate within the Transitway tunnel originating at South Station and extending to BMIP and to Summer and Fargo Streets. However, the demand levels anticipated for the high growth scenario would require an increased headway of 1.6 minutes on the BMIP route and 3.5 minutes on the Summer/Fargo Streets route.

Supplemental Bus Routes

The two MOS Alternatives would be supplemented by shuttle, local, and express buses, as shown in Table 2-6. These supplemental routes are intended to (1) provide good connections to the Piers area for residents of adjacent residential areas (*i.e.*, South Boston, Chinatown, North End) where such connections are not provided by Transitway services; (2) eliminate the need for any suburban commuters to make two transfers (*i.e.*, three-seat rides) to reach the Piers area; and (3) provide connections to the eastern (BMIP) end of the Piers area where Transitway service does not provide such a connection.

Shuttle Routes

As shown previously in Figures 2-11 and 2-13 for the MOS-1 and MOS-2 Alternatives, respectively, shuttle service would be provided on a North Station to Piers area route, as well as on routes to the Piers area from both Copley and New England Medical Center Stations. These latter routes originating in the downtown area would accommodate the large volume of trips to the Piers area expected to originate on the Green and Orange rapid transit lines while minimizing the number of transfers required to reach the Piers area. Two routes would originate at both Copley and New England Medical Center Stations, one to serve the Piers area and the other to serve BMIP. These routes would operate to the Piers area and BMIP at 7.5-minute headways via the Seaport Access Road. Shuttles destined to the Piers area would operate in a counter-clockwise manner, while the BMIP route would continue via the Massport Haul Road and Northern Avenue before circulating through BMIP.

Local Routes

Local routes in the MOS Alternatives include: Route 7, an existing MBTA route operating as a surface loop on Federal and Franklin Streets; South Boston/Bayview, a new local service operating from the Bayview area of South Boston to the Piers area in order to improve access to employment opportunities for residents of South Boston; and Route 6, an existing MBTA Piers area route operating from North Station to BMIP via the North End.

Express Routes

Express bus services would not be needed to supplement other services provided by the MOS Alternatives in the lower growth scenario due to lower levels of development expected in the Piers area. For the high growth scenario, however, express buses would be needed to help serve more intensive development. Thus, in the high growth operating plan, express service would be provided from outlying areas. Like the shuttle service, express buses would be provided in corridors of high levels of demand where riders would otherwise need to transfer twice. These routes would originate in the same three corridors as in the Bus/TSM Alternative: I-90, I-93, and the North Shore (via the Third Harbor Tunnel). Each express route would operate at 15-minute headways. North Shore and I-90 express buses would have wider distribution loops in the MOS Alternatives compared to the Bus/TSM Alternative. Lower bus volumes on surface streets in the MOS Alternatives afforded by the underground alignment would enable this wider circulation with minimal traffic and environmental impacts.

TABLE 2-6: SUPPLEMENTAL SURFACE BUS ROUTES IN THE MOS ALTERNATIVES

Type of Route	Description	Lower Growth Scenario		High Growth Scenario	
		Headway (minutes)	Buses Per Hour	Headway (minutes)	Buses Per Hour
Shuttle Bus	North Station to Piers	3.3	18	2.4	25
Shuttle Bus	New England Medical Center to Piers	7.5	8	7.5	8
Shuttle Bus	New England Medical Center to BMIP	7.5	8	7.5	8
Shuttle Bus	Copley to Piers	7.5	8	7.5	8
Shuttle Bus	Copley to BMIP	7.5	8	7.5	8
Local Bus	North Station to BMIP (#6)	7.5	8	7.5	8
Local Bus	City Point to Downtown (#7)	12	5	8.5	7
Local Bus	South Boston to South Station via Bayview	15	4	15	4
Express Bus (via I-93)	Mishawum	0	0	15	4
Express Bus (via I-93)	Burlington	0	0	15	4
Express Bus (via I-90)	Waltham/Watertown	0	0	15	4
Express Bus (via I-90)	Allston/Reservoir	0	0	15	4
Express Bus (North Shore via Tunnel)	Orient Heights/Winthrop	0	0	15	4
Express Bus (North Shore via Tunnel)	Lynn/Salem	0	0	15	4
Express Bus (North Shore via Tunnel)	Revere/Malden	0	0	15	4
Express Bus (North Shore via Tunnel)	Chelsea/Everett	0	0	15	4

Standard buses to be used on all routes.

Local and express bus routes for the MOS-1 and MOS-2 Alternatives were shown previously in Figures 2-12 and 2-14, respectively.

Vehicle Requirements

In addition to the trackless trolleys required for service in the Transitway tunnel, standard diesel transit buses would be used on the supplementary bus routes. Table 2-7 summarizes vehicle requirements for the MOS Alternatives under the high and lower growth scenarios. The number of trackless trolleys required includes a 20 percent spare ratio, and 15 percent spares are included in the standard bus requirements.

Operating Speeds

Operating speeds for Transitway service under the MOS Alternatives would vary with tunnel and surface operation. Tunnel sections are assumed to have a maximum design speed of 30 miles per hour on tangents (straight line segments), while curves would have a design speed of 10 miles per hour. Speeds for surface operation (east of the portal at either World Trade Center or Fan Pier) would be consistent with the speeds assumed for the bus operations in the No Action and Bus/TSM Alternatives. In the Piers area, 6 miles per hour would be assumed for the route to Summer and Fargo Streets; the BMIP route is assumed to operate at the same speed with the exception of the loop into BMIP, where a higher speed of 10 miles per hour is expected to be achieved.

TABLE 2-7: VEHICLE REQUIREMENTS FOR MOS ALTERNATIVES

		Supplemental Services		
Alternative	***Articulated Transitway Vehicles***	***Local/ Shuttle Buses***	***Express Buses***	***Total Buses***
Lower Growth Scenario				
MOS-1/MOS-2	***21***	***67***	***0***	***88***
High Growth Scenario				
MOS-1/MOS-2	***32***	***79***	***55***	***166***

2.3.3.4 Service Plan for the Full Build Alternative

In the Full Build Alternative, service in the Underground Transitway would consist of three routes. Two of these routes would originate at Boylston Station and operate through the Transitway tunnel to the D Street portal in the Piers area; at that point, the two routes would diverge. One route would operate north along D Street to Northern Avenue, continuing east to BMIP. The other route would travel south on D Street in order to serve a concentration of office development on Summer Street. Headways of approximately 1.6 minutes would be operated on each route.

In addition, an existing MBTA route to downtown Boston that currently operates on surface streets would be rerouted into the Transitway tunnel. This route is Route 7, connecting City Point to downtown. Operation of Route 7 in the Transitway tunnel would improve access from the South Boston residential neighborhood to Boston's CBD.

The potential exists for future through-routing of Replacement Transit (Washington Street) service with the Transitway at Boylston Station. The Replacement Transit Improvement Project (RTIP) would replace the elevated Orange Line on Washington Street which was relocated into the Southwest corridor rail right-of-way in the spring of 1987. The objective of RTIP is to provide improved transit service between Dudley Square and downtown Boston.

Integration of the Transitway and RTIP services at Boylston Station would require reactivation of the Tremont Street portal at Pleasant Street in the vicinity of New England Medical Center; renovation of this portal would be accomplished as part of RTIP. A tunnel connection would also need to be built between the Transitway station at Boylston and the Tremont portal. Current plans, however, envision initial RTIP service as an entirely surface operation terminating in the vicinity of Avenue de Lafayette and Washington Street. Transfers would be made to the Chinatown Station of the Transitway at that location. Any through-routing connection between the RTIP and Transitway services is considered a future phase of both projects; as such, the model used to forecast travel demand for the South Boston Piers/Fort Point Channel Transit Project does not incorporate any connection with RTIP service. The current design of the Transitway tunnel and platforms at Boylston Station and elsewhere along the alignment would not preclude such future connections. Boylston Station would be designed with a turnback loop that could accommodate short turn services on either Transitway or RTIP service should a connection become desirable.

Operating details of the Transitway routes included in the Full Build Alternative service plan are summarized in Table 2-8.

Figure 2-15 depicts the Full Build Transitway routes. Local and express routes supplementing Transitway service are shown in Figure 2-16.

Operating Strategy for Transitway Routes

The operating strategy for the Transitway Full Build Alternative is based on the concept of providing high frequency service with large capacity articulated vehicles. Three routes would share the Transitway tunnel between Boylston Station and World Trade Center Station. These routes would diverge at the World Trade Center Station/D Street tunnel portal. One route would serve the Summer Street development area, a second would continue to City Point, and the third route would serve BMIP. Up to 89 buses per hour would operate into and out of the Transitway tunnel.

Supplemental Bus Routes

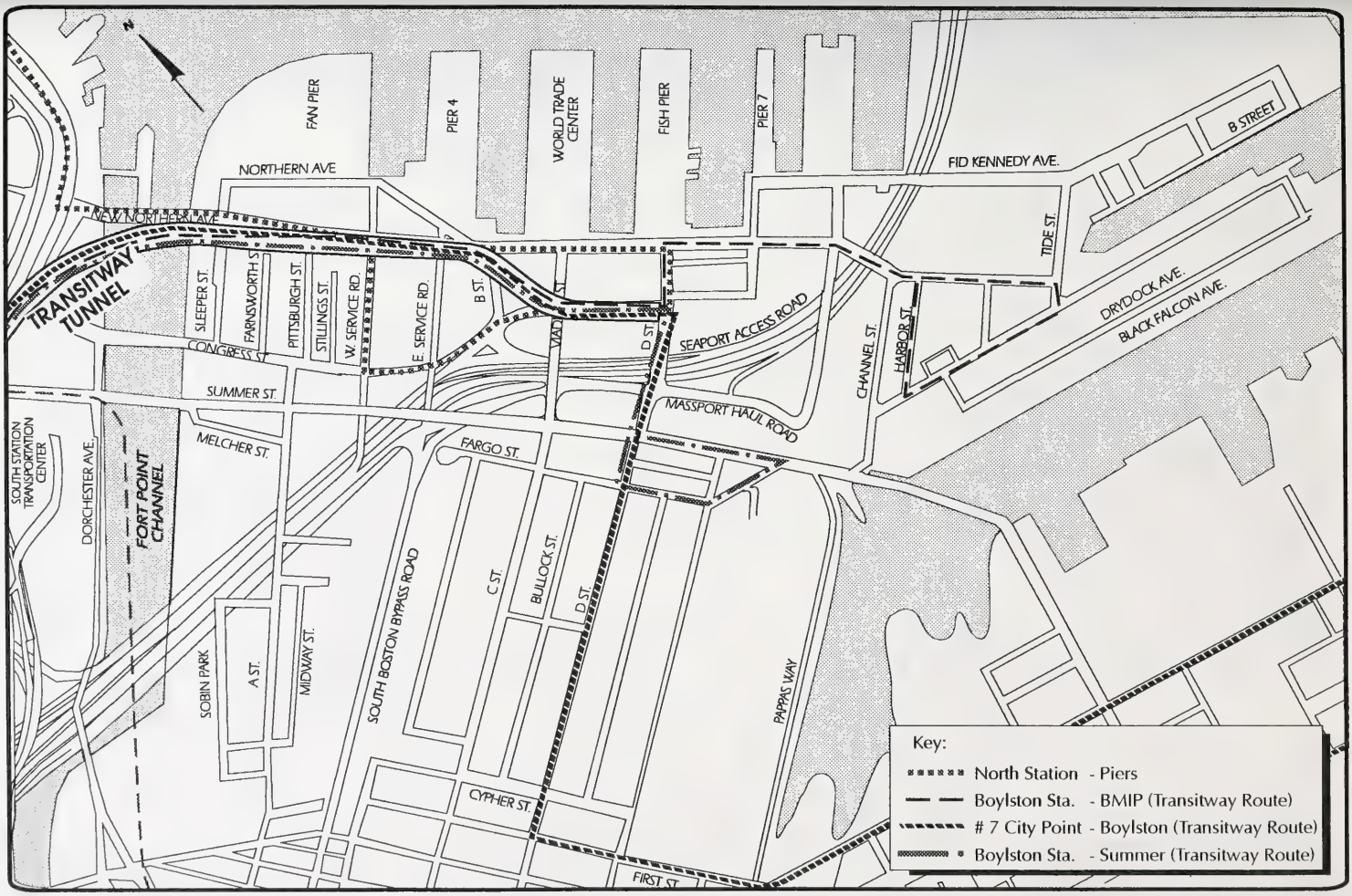
As in the MOS Alternatives, supplemental bus service is provided in the Full Build Alternative to enhance access for residents of adjacent neighborhoods and to enable better connections for commuters into the area. The three components of this supplemental service — shuttle, local, and express routes — are shown in Table 2-9.

Shuttle Routes

Shuttle service would be provided on one route — North Station to the Piers area — in the Full Build Alternative. Because transit riders from the north side commuter rail network would otherwise need to transfer twice to reach the Piers area, this shuttle is intended to facilitate the trip for commuters from the north. Shuttle service from Copley and New England Medical Center Stations offered in the two MOS Alternatives would not be necessary in the Full Build Alternative; direct Transitway connections to the Green and Orange Lines would be provided at Boylston Station and Chinatown Station, respectively.

TABLE 2-8: OPERATING DETAILS: TRANSITWAY ROUTES (FULL BUILD ALTERNATIVE)

Route Description	Headway (minutes)	Buses Per Peak Hour	Peak Hour Capacity (Design)
Lower Growth Scenario			
Boylston Station to BMIP	2.6	23	2,230
Boylston Station to Summer/Fargo Streets	2.6	23	2,230
City Point to Downtown (Route 7)	5.5	11	1,070
High Growth Scenario			
Boylston Station to BMIP	1.6	38	3,690
Boylston Station to Summer/Fargo Streets	1.6	38	3,690
City Point to Downtown (Route 7)	4.6	13	1,260



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

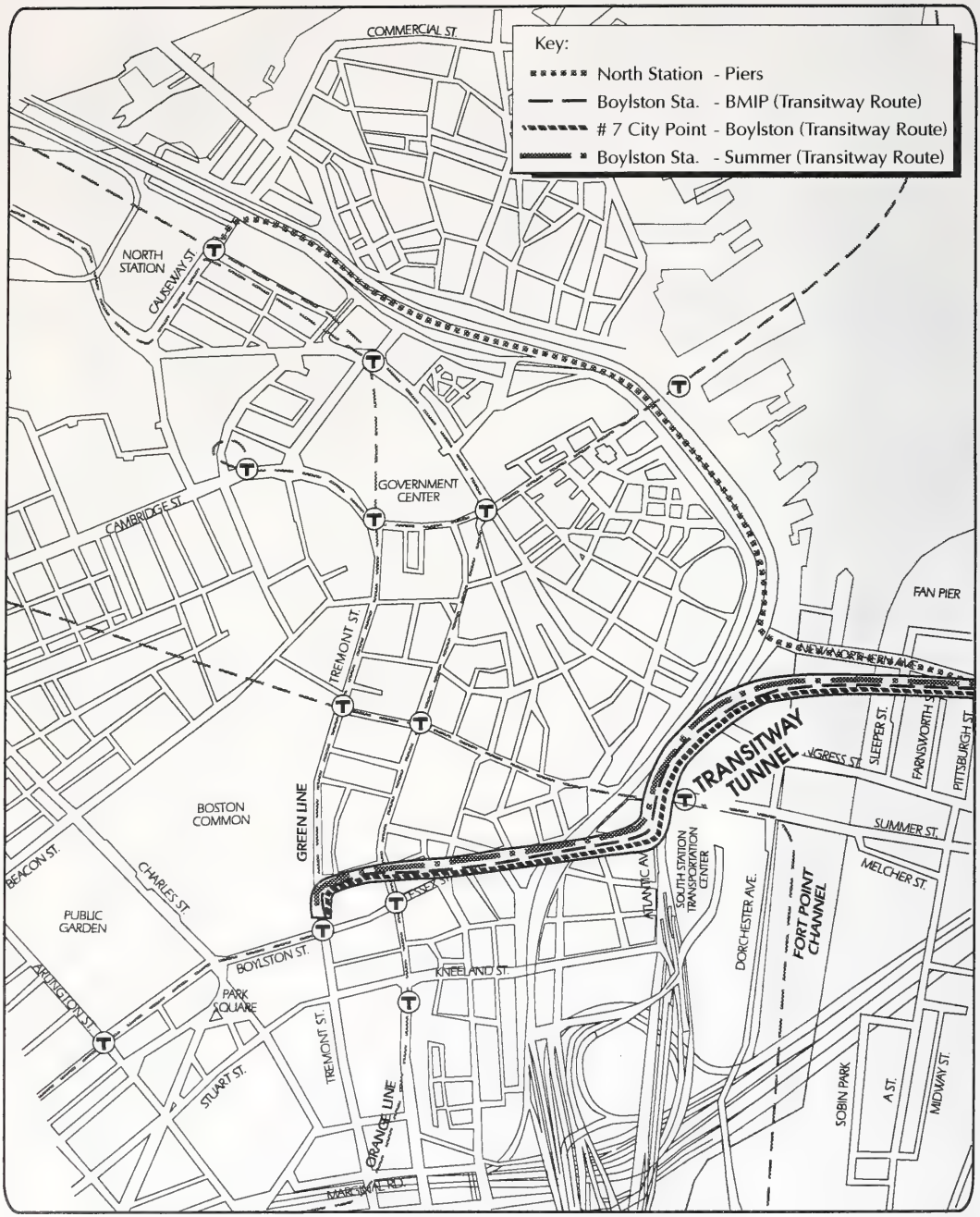
South Boston Piers/ Fort Point Channel Transit Project

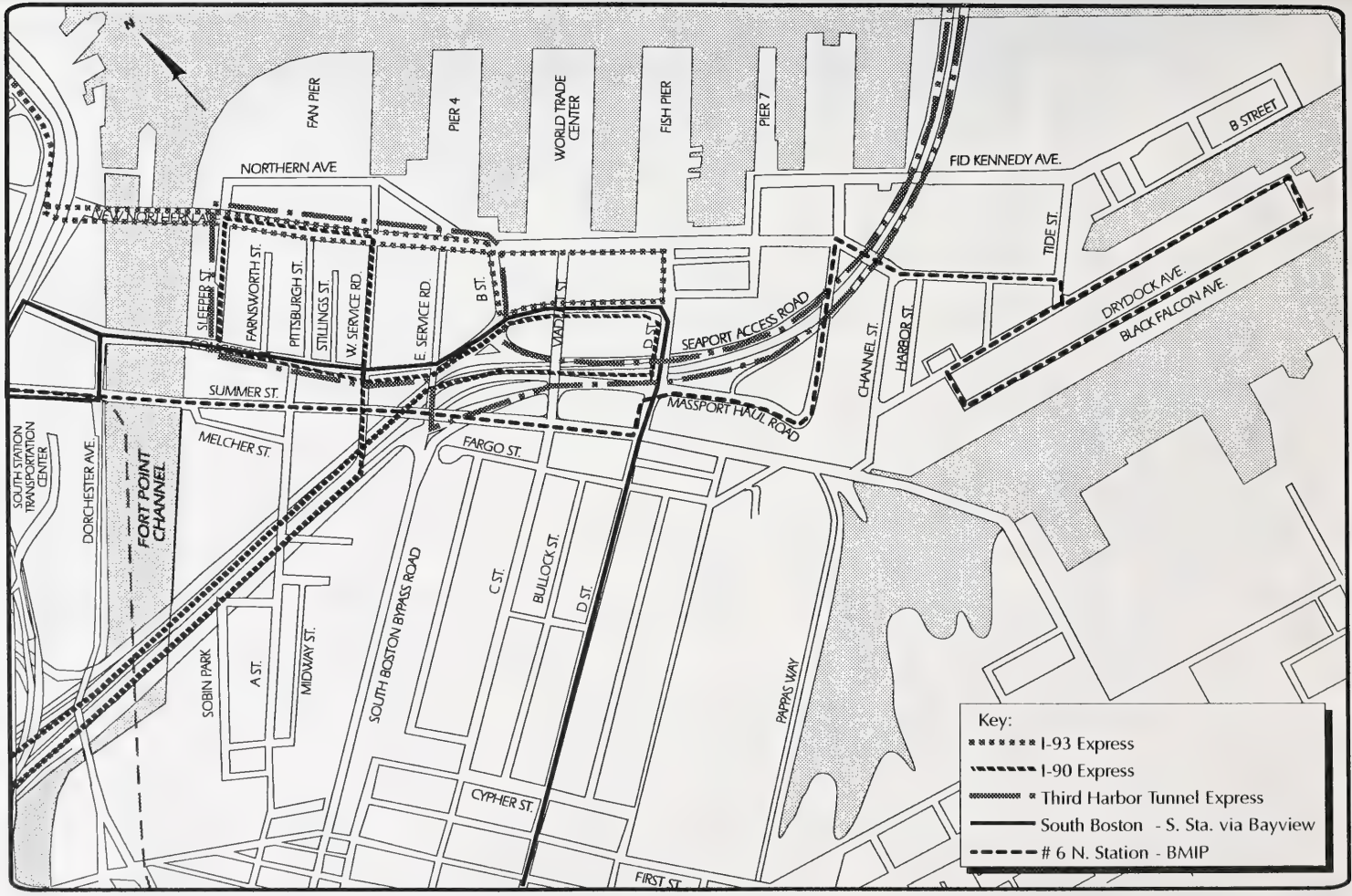
Fig. 2-15, 1 of 2
Full Build Alternative - Piers Area Shuttle and Transitway Routes

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-15, 2 of 2
Full Build Alternative
Downtown Area
Shuttle and Transitway
Routes





MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-16, 1 of 2
Full Build Alternative - Piers Area
Express and Local Routes

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fg. 2-16, 2 of 2
Full Build Alternative
Downtown Area
Express and Local
Routes

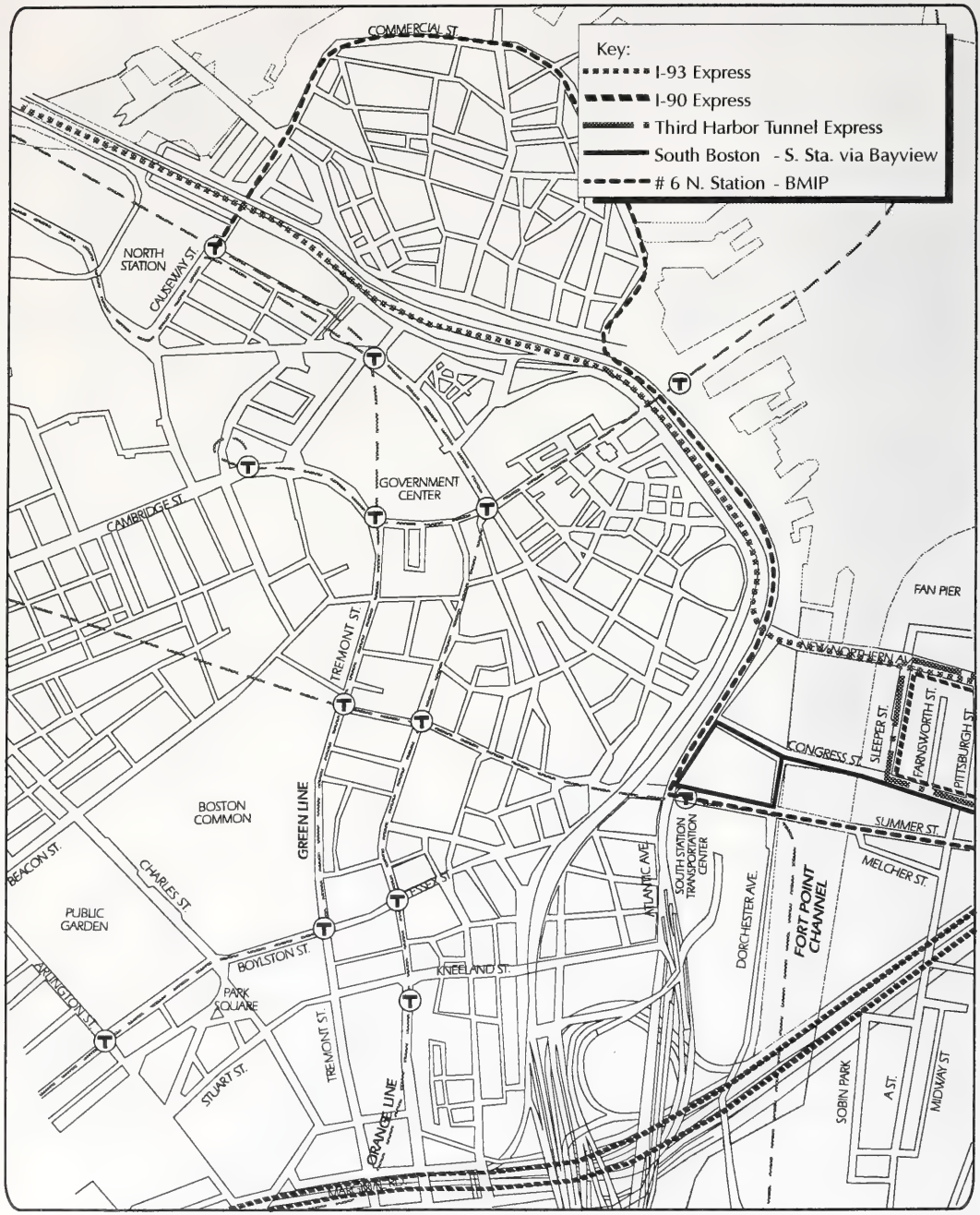


TABLE 2-9: SUPPLEMENTAL SURFACE BUS ROUTES IN THE FULL BUILD ALTERNATIVE

Type of Route	Description	Lower Growth Scenario		High Growth Scenario	
		Headway (minutes)	Buses Per Hour	Headway (minutes)	Buses Per Hour
Shuttle Bus	North Station to Piers	5.0	12	3.5	17
Local Bus	North Station to BMIP (#6)	7.5	8	7.5	8
Local Bus	South Boston to South Station via Bayview	15	4	15	4
Express Bus (via I-93)	Mishawum	0	0	15	4
Express Bus (via I-93)	Burlington	0	0	15	4
Express Bus (via I-90)	Waltham/Watertown	0	0	15	4
Express Bus (via I-90)	Allston/Reservoir	0	0	15	4
Express Bus (North Shore via Tunnel)	Orient Heights/Winthrop	0	0	15	4
Express Bus (North Shore via Tunnel)	Lynn/Salem	0	0	15	4
Express Bus (North Shore via Tunnel)	Revere/Malden	0	0	15	4
Express Bus (North Shore via Tunnel)	Chelsea/Everett	0	0	15	4

Standard buses to be used on all routes.

Local Routes

Local service would be provided on two routes designed to connect residential areas to the Piers area: (1) Route 6, an existing MBTA route operating from North Station to BMIP via the North End; and (2) the South Boston to South Station via Bayview route, a new local service intended to improve access for residential South Boston to employment opportunities in the CBD and developing Piers area.

Express Routes

Express service provided in the Full Build Alternative would be the same service provided in the high growth service plan for the MOS Alternatives. See Page 2-46 for a discussion of these routes.

Vehicle Requirements

In addition to the trackless trolleys required for service in the Transitway tunnel, standard diesel transit buses would be used on the supplementary bus routes. Table 2-10 summarizes vehicle requirements for the Full Build Alternative. The number of trackless trolleys required includes a 20 percent spare ratio, and 15 percent spares are included in the standard bus requirements.

TABLE 2-10: VEHICLE REQUIREMENTS FOR FULL BUILD ALTERNATIVE

		Supplemental Services		
Alternative	***Articulated Transitway Vehicles***	***Local/ Shuttle Buses***	***Express Buses***	***Total Buses***
Lower Growth Scenario				
Full Build	***36***	***28***	***0***	***64***
High Growth Scenario				
Full Build	***53***	***35***	***55***	***143***

Operating Speeds

Operating speeds for Full Build Transitway service would be the same as speeds in the MOS Alternatives. See page 2-48 for a discussion of operating speeds.

2.3.3.5 Transitway Design Criteria

Design Criteria

A set of design criteria has been established for the Transitway Alternatives as follows. These criteria reflect the operation of electric articulated buses which, within the limit of the Transitway tunnel, will serve manned stations equipped with fare collection turnstiles and configured with platforms having a height compatible with low floor vehicles. Specifics relating to the vehicle design are still in the development and analysis stage. Design criteria are as follows:

- Minimum Vertical Clearance in Tunnel (from top of roadway to underside of structure)

  15'-3" minimum
  16'-9" preferred
  14'-6" allowable at crossover and station areas due to severe vertical restrictions

- Minimum Side Clearance in Tunnel (Tangent)

  7'-0" to fixed structure from roadway centerline
  8'-0" to wall at walkway from roadway centerline

  (Minimum Tunnel Cross Section - 15'-0")

- Operating Speed in Tunnel - 30 mph (nominal maximum)

- Vehicle Length - 60 feet overall
  Vehicle Width - 102 inches overall

- Vehicle Capacity - 97 passengers

- Maximum Transitway Tunnel Gradient - 5% preferred
  - 6% maximum where conditions prohibit 5% or less

- Minimum Transitway Curvature - 50 feet

- Platform Length - 220 feet (for simultaneous berthing of three vehicles)

- Platform Height - 8 inches (approximate) depending on low floor vehicle final design parameters

- Stations - prepayment manned facilities with stairway, elevator, and escalator access to platforms

- Tunnel Electrification - 600 V d.c.

Tunnel Depth and Grade

The portion of the Transitway tunnel west of South Station would be 60 to 70 feet below grade to the bottom of the tunnel due to the necessity of tunneling under the Orange Line, the proposed Kingston/Bedford development parking garage, and the Central Artery tunnel in Dewey Square. Along Atlantic Avenue, the Transitway would be jointly constructed with the depressed northbound Central Artery. For the Fort Point Channel crossing, the Transitway tunnel floor would be approximately 25 feet below the bottom of the channel. This dimension is driven primarily by the need to provide an internal tunnel vertical clearance of approximately 17 feet. East of the Fort Point Channel, the Transitway would be constructed at a minimum of 25 to 30 feet below grade.

In the MOS-1 Alternative, a portal would be placed in the vicinity of Courthouse Station. The transition segment to surface at this point would be constructed at 7 percent grade for the portal (boat section) to New Northern Avenue near Pittsburgh Street. A short tunnel extension would be provided at this location to allow for a future underground extension to the World Trade Center.

Typical Underground Sections

The Transitway tunnel could be constructed by cut-and-cover methods, with the exception of ***the turnaround loop at Boylston Station***, the section between the proposed Chinatown Station and South Station, ***the section beneath the Russia Wharf Building***, and the Fort Point Channel crossing. ***The historic and potential archaeological sensitivity of Boston Common and the Central Burying Ground adjacent to Boylston Station requires hand mining of the turnaround loop at Boylston Station.*** Due to right-of-way constraints and the need to cross under the Orange Line, the section between Chinatown and South Station would be constructed by deep bore tunneling. The deep bore tunnel would consist of two separate tubes from just west of the Orange Line to just east of the Dewey Square tunnel. ***Underpinning will be necessary beneath the Russia Wharf Buildings due to the massive size and close spacing of the pile clusters supporting the building.*** The Fort Point Channel crossing would utilize either cofferdam or immersed tube construction techniques. Cut-and-cover sections would consist of a large reinforced concrete box with a center wall for intermediate support.

Station Design Standards

Transitway station designs would vary with the requirements of each site. The three stations where existing rapid transit lines are intersected — Boylston, Chinatown, and South Stations — each have unique requirements for providing connections to existing service. In addition, these three stations are sited in densely developed physically constrained areas. Station orientation and location maps were presented previously in Figure 2-9.

Standard criteria were used in developing station layouts for the Transitway. Platforms were designed to be 220 feet in length, in order to accommodate three 60-foot vehicles at one time. A low floor vehicle design is contemplated whereby the interior passenger compartment floor can be accessed directly from a low (curb height) platform. Platform height specifications have not been finalized, but would be developed in conjunction with vehicle technology to facilitate passenger boardings and to provide a consistent approach to handicapped accessibility within the Transitway tunnel.

World Trade Center Station

The World Trade Center Station would be constructed in the Full Build and MOS-2 Alternatives. This station would be the most easterly station in the Piers area. The station would be located immediately west of the transition section to surface at D Street, beneath the planned Massport replacement parking garage. Direct pedestrian stairways from the elevated street level at Viaduct Street down to a mezzanine level would be provided, as well as at-grade pedestrian entrances from C and New Congress Streets to the mezzanine level. The mezzanine would provide access over the Transitway to a central stair and escalator, which would descend to platform level, where a center platform would be provided. This central platform configuration would allow the consolidation of vertical circulation elements and fare collection facilities in the new station.

Handicapped access would be provided by two elevators. One would lead down from street level to the mezzanine level. The mezzanine would provide access over the Transitway to a second elevator which would reach platform level.

Courthouse Station

Courthouse Station (previously referred to as Fan Pier Station in the DEIS/SDEIR) would exist as a tunnel station in the Full Build and MOS-2 Alternatives. In the MOS-1 Alternative, the station would consist of a surface stop just east of the Transitway portal beneath New Northern Avenue between Farnsworth and Pittsburgh Streets. The underground station would be located on the west side of Pittsburgh Street. Surface entrances would be constructed on both sides of New Northern Avenue, which would provide access to a mezzanine level. Fare collection would take place at the mezzanine level. Escalators would provide access to the station's center platform for vehicle boarding.

The MOS-1 Alternative involves a less elaborate surface facility at the Fan Pier/Courthouse location. A Courthouse surface stop would more closely resemble a Green Line surface median stop, such as Boston University or Northeastern University. While benches, shelters, and lighting would be provided at the surface facility, no fare collection would be provided. Passengers would pay fares when boarding the vehicle in a manner similar to the Green Line surface stops noted above. However, the MOS-1 Alternative would include a short tunnel stub containing an unfinished station box in order to permit a future underground extension to World Trade Center Station. Vehicles would use a temporary incline to reach New Northern Avenue. The tunnel box for a future Courthouse Station would be located beneath that incline.

South Station

All alternatives include a Transitway station at South Station. A Transitway station has been designed to meet the spacial constraints and unique characteristics of the South Station site. A new lobby one level below street level would serve passengers using either the Underground Transitway or the Red Line. Directly below the lobby would be the new Transitway platform. The Transitway platform would cross over the existing Red Line platforms at an elevation just above the current Red Line station lobby floor. The depth of the existing platform level permits construction of both the new lobby and the Transitway platform between the existing street level and what is now the floor of the Red Line station lobby.

This station configuration would allow simple, direct vertical transfers between the Transitway and Red Lines. Transit riders at South Station would have convenient access to street level at all four corners of the Summer Street/Atlantic Avenue intersection. In addition, ready access would be available to intercity and commuter rail and bus facilities at the South Station Transportation Center. In the new South Station Transitway station, the lobby would also serve as a pedestrian pass-through under Dewey Square.

Where feasible, the design of the South Station Transitway station incorporates recent improvements to the existing Red Line station, and it would appear that almost all of the existing street level entrances can be used in the new station. Stair and escalator lengths may be modified as necessary. The pedestrian passageway to the basement of South Station would also be retained. However, the construction of a new lobby and Underground Transitway platform would involve extensive demolition and reorganization of the station interior above the existing lobby level, including most if not all of the existing internal stairways and escalators.

Chinatown Station

A Transitway station would be constructed in midtown as part of the Full Build Alternative. Located beneath Hayward Place, this station would be adjacent to a proposed development parcel — the Hayward Parcel — which is bordered by Hayward Place, Washington Street, Avenue de Lafayette, and Harrison Avenue Extension. Its proximity to existing Chinatown Station would facilitate transfers to and from the Orange Access between the Transitway station and the southbound Orange Line would require construction of a pedestrian passageway. Pedestrian connections would also be provided to proposed developments ***at the Hayward parcel as well as at future development of Parcel 30/Keith Block bordered by Tremont, Boylston, Washington, and Avery Streets.*** The actual configuration of these connections depend upon further refinement of development plans for the two parcels. Consistent with the MBTA's convention of using a single station name to identify stations serving multiple transit lines, this Transitway station would be named Chinatown Station.

Boylston Station

The westernmost station in the Full Build Transitway Alternative would be located beneath the current Boylston Green Line Station. Transitway vehicles would arrive at a new lower level of Boylston Station from the Avery Street tunnel one level below current Green Line operations. Provision would be made for a future operational connection to the Replacement Transit Improvement Project service.

Vehicle circulation within Boylston Station would be dictated by existing tunnel and right-of-way constraints. All vehicles would enter at the eastern end of the station and circulate counter-clockwise around a large center platform.

Vertical pedestrian circulation elements would be provided to both Green Line platforms above. In addition, a pedestrian walkway under Tremont Street could be constructed from a small mezzanine level to Parcel 30/Keith Block.

Because of potential impacts to Boston Common due to construction of this Transitway station and the approach tunnels, a construction scheme that avoids excavation from the Common surface and mitigates traffic impacts on Tremont Street has been developed. This is discussed in detail in Chapter 5, Section 5.12.5 and is reflected in the project's capital cost estimates.

Alignment and profile, typical sections, and station design drawings are presented in the separately bound *Design Drawings Appendix* to this FEIS/FEIR.

2.3.3.6 Electrification and Signalization

Electrification

Dual trolley wire would be suspended from the ceiling of the Transitway tunnel on all subsurface sections of the Transitway. ***Overhead catenary would need to be installed at the street level for surface operation of the Transitway vehicles.***

Signalization

Signalization for vehicle movement within the tunnel portion of the Transitway would be developed based on the need to regulate headways, control departure times from stations, and accommodate sight distances and safe braking distances within the confines of the tunnel. Communications systems, intrusion alarms, and other supervisory control functions would be compatible with existing MBTA facilities. It is expected that Transitway dispatching and supervisory control functions would be monitored from the 45 High Street Operations Center.

2.3.3.7 Vehicle Criteria

Vehicle configuration would be the same for all Transitway Alternatives. The buses would be articulated with an overall length of 60 feet and a maximum width of 102 inches. The dimensions would permit operation on city streets in compliance with city and state motor vehicle regulations. Assuming 3.0 square feet for each standee, total capacity would be approximately 97 passengers. ***Low floor vehicles would facilitate passenger boarding and provide accessibility to persons with disabilities.*** Surface operation would provide accessibility via standard on-board lifts.

Standard 40-foot buses would be used on supplementary bus services. These would be equipped with on-board lifts and wheelchair tiedowns.

2.3.3.8 Maintenance Facility

The articulated trackless trolleys used in Transitway service would require a dedicated maintenance and storage facility. As described previously in Section 2.3.2.3, two potential sites for the facility (shown previously in Figure 2-7) have been identified for the Bus/TSM Alternative. One of these sites would also be used for a maintenance and storage facility to support the vehicles operated under the Transitway Alternatives. The location of the site within roughly 0.5 miles of the Transitway portal at D Street minimizes deadheading and the extent of on-street installation of overhead trolley wires. (Deadheading is a non-passenger carrying journey of a transit vehicle encompassing the distance between the vehicle storage/maintenance facility and the point where the passenger service route begins or terminates. As such, this is a non-revenue producing operation.) While both sites are large enough to accommodate

service bays, hoists, and aisleways of an adequate size to store and maintain the 60-foot articulated Transitway vehicles ***and standard diesel buses, Site B, which is somewhat smaller than Site A, would require construction of employee parking on the facility's roof. This rooftop parking makes Site B a more expensive facility, at an additional cost of approximately $10 million. This higher cost is reflected in the capital costs for the Transitway Alternatives.***

The facility as shown in Figure 2-17 would accommodate maintenance and storage requirements for the Full Build Transitway vehicle fleet (both articulated and standard buses) with some room for future expansion; ***it would also accommodate the vehicle fleets for the MOS Alternatives. A simplifying assumption used in the preparation of capital costs is that the same facility would be constructed for all three Transitway Alternatives. This assumption will permit future expansion without the associated costs of redesigning and reconstructing the fixed facility. It is similar to the approach taken for estimating the costs of other fixed facilities (such as stations) among alternatives. Costs for such facilities are the same regardless of alternative, although more capacity may be provided than is needed in the short-term. However, costs for the facility will differ depending upon growth scenario. Since (1) fewer vehicles are needed in the lower growth scenario under all alternatives and (2) the maintenance and storage facility size is based upon vehicle fleet size, the cost of the lower growth facility will be less than in the high growth scenario. This difference is reflected in the capital cost estimates.***

2.3.3.9 Fare Collection Methods

Fare collection would vary between tunnel and surface operation on Transitway routes. For tunnel operation, fare collection would be at manned turnstile arrays in a configuration similar to current rapid transit operations. Entrance would be made through the use of a prepaid pass or the purchase of a token. Station fare collection would minimize dwell time in the station for transit vehicles. In addition, off-vehicle fare payment allows for left side vehicle boarding from center platforms since passengers need not pass by the operator upon boarding. Fare collection for surface operation in the Piers area would resemble that used for conventional MBTA bus service. Passengers would either display a pass to the operator or deposit the appropriate fare in the farebox.

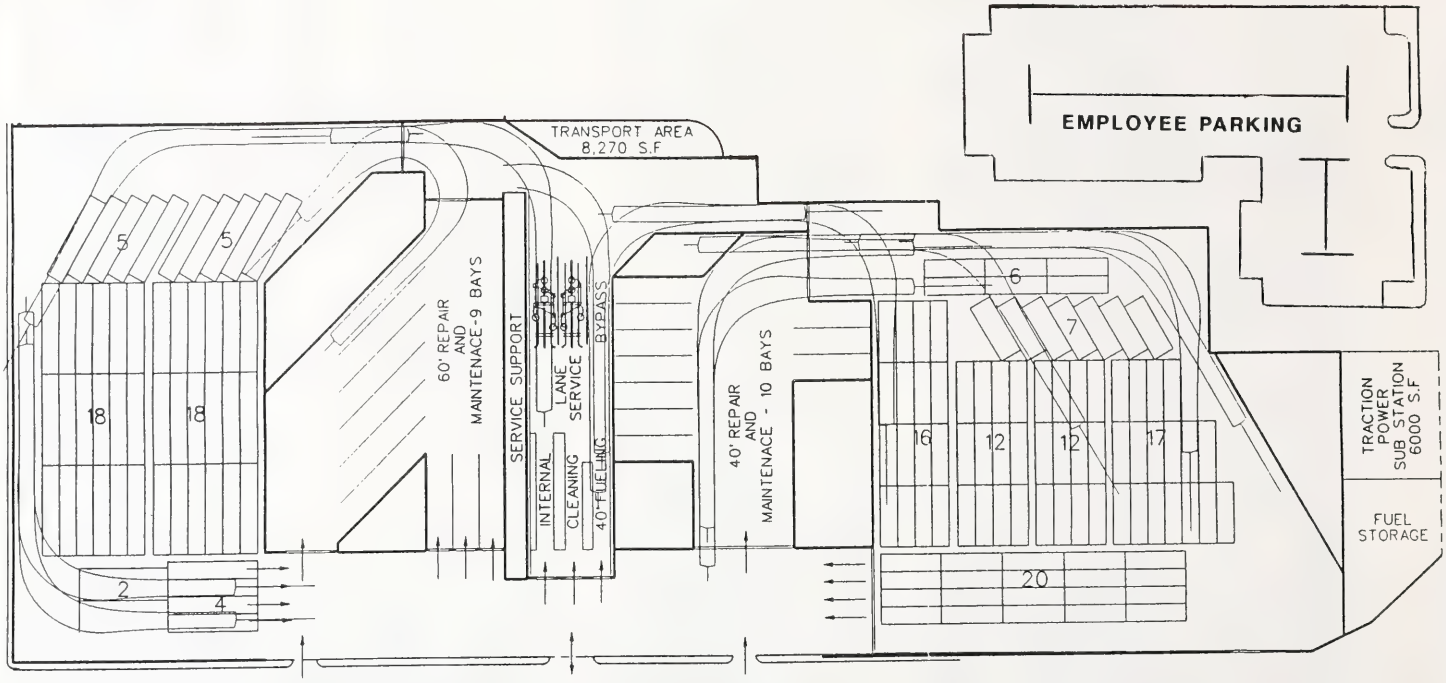
2.4 CAPITAL COSTS

The MBTA has estimated the capital costs for the South Boston Piers Transit Project alternatives based on unit costs for each capital item. Sources for these unit costs include similar construction activities in the Boston area and in the Northeast region. Where available and applicable, previous MBTA and Massachusetts Highway Department construction cost data were utilized.

To reflect the uncertainty about some project elements, a 10 percent contingency has been applied to Transitway construction contracts that are less than 30 percent designed. Thus, a contingency has been applied to all contracts except CC01, which is already fully designed.

The contingencies used in the MBTA's capital cost estimate are considerably lower than those being used across the country for other fixed guideway transit projects. The higher contingencies used for other projects reflect a consistent history of cost overruns for projects of this scope and complexity, and a lack of engineering detail at this stage of project planning. The MBTA believes that the capital cost estimates for the South Boston Piers Transit Project alternatives are reasonably accurate. According to the MBTA, a conservative approach was taken in developing the estimate, and the Authority has a history of completing major construction projects on schedule.

Engineering and construction support costs were calculated as 10 percent of the cost for structures and systemwide elements (less vehicles) plus either 2 percent of the costs for vehicles in the Bus/TSM and MOS Alternatives or 1.5 percent of the vehicle costs in the Full Build Alternative.



NOTE:
Layout shown is generic and illustrative purposes only.
Actual site plan configuration will be dependant upon final site selection.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-17
Maintenance Facility
Typical Full Build Configuration

Project administration costs represent 3.5 percent of the costs for structures, systemwide elements (less vehicles), and engineering and construction support, plus 1 percent of vehicle costs. Force account costs represent estimated utility force account work plus 1 percent of vehicle costs.

Capital costs for the project alternatives are presented in 1993 dollars in Tables 2-11 through 2-19. Capital costs are presented for the high and lower growth scenarios, due to the differences in vehicle quantities. Table 2-20 presents a summary of capital costs by alternative.

2.5 OPERATING AND MAINTENANCE COSTS

Annual operating and maintenance (O&M) costs have been prepared for each alternative. The methodology for preparing these costs involved development of resource build-up models for each of two modes — surface buses and trackless trolleys/dual mode buses — operated in the alternatives. Line items in each model consist of the standard FTA accounts, assembled into four major expense categories:

- *Transportation* - all functions related to movement of passengers and equipment over the network, including operator wages and fringes; fuel and lube; tires and tubes; administration and scheduling of transportation operations; and station operations.

- *Equipment* - maintenance and servicing of all equipment, excluding fixed facilities, such as revenue vehicles; service vehicles; and fare collection equipment.

- *Way and Structures* - maintenance of all fixed facilities, including vehicle control systems; roadway, track, and structures; passenger stations; buildings, grounds, and equipment; communication systems; and electric power facilities.

- *Administrative* - systemwide support services, including passenger service and planning, accounting, insurance, police, labor relations, and materials storerooms.

Unit costs were defined for each line item, and the unit of service (typically expressed in terms of vehicle-miles, vehicle-hours, peak vehicles, garages, passengers, stations, or track-miles) was established for each mode. The cost of each line item was then calculated by multiplying unit costs by the unit of service, incorporating a productivity ratio expressed as a resource-required-per-unit-of-service. The resulting costs were then applied to the service levels and modes of each project alternative. A complete description of this methodology and details on each model are provided in *Operating and Maintenance Cost Methods and Results Report* (MBTA, January 1992).

The primary data source for the O&M models is the MBTA 1986 (calendar year) operating expense reporting system. Unit costs derived from this system were inflated to 1993 dollars. The MBTA's Responsibility Accounting System (RAS) and Modal Cost Allocation System (MCA) were also used to provide detailed line item expenses for each MBTA department and to allocate expenses by mode.

Tables 2-21 through 2-25 present O&M costs and staff requirements for each alternative by expense category. A summary of O&M costs and staffing is provided by alternative in Table 2-26.

TABLE 2-11: MBTA CAPITAL COST ESTIMATE FOR NO ACTION ALTERNATIVE

Item	Cost
1. SYSTEMWIDE ELEMENTS	
Bus Shelters	$216,295
Vehicles	6,408,734
2. ENGINEERING AND CONSTRUCTION SUPPORT	149,804
3. PROJECT ADMINISTRATION	71,658
4. FORCE ACCOUNT	64,087
5. CONTINGENCY	662,503
TOTAL COST (1993$)	$7,573,081

TABLE 2-12: MBTA CAPITAL COST ESTIMATE FOR BUS/TSM ALTERNATIVE HIGH GROWTH SCENARIO

Item	Cost
1. TSM STRUCTURE	
Bus Lane	$330,137
Pullout Berths	178,317
Median Widening	38,635
Surface Stations	337,980
2. SYSTEMWIDE ELEMENTS	
Signals	160,218
Bus Shelters	905,234
Vehicles	34,820,785
Maintenance Facilities	8,603,496
Right-of-Way	5,458,500
3. ENGINEERING AND CONSTRUCTION SUPPORT	2,242,958
4. PROJECT ADMINISTRATION	968,001
5. FORCE ACCOUNT	348,208
6. CONTINGENCY	5,356,255
TOTAL COST (1993$)	$59,748,725

TABLE 2-13: MBTA CAPITAL COST ESTIMATE FOR BUS/TSM ALTERNATIVE LOWER GROWTH SCENARIO

Item	Cost
1. TSM STRUCTURE	
Bus Lane	$ 0
Pullout Berths	178,317
Median Widening	0
Surface Stations	337,980
2. SYSTEMWIDE ELEMENTS	
Signals	160,218
Bus Shelters	906,547
Vehicles	14,526,463
Maintenance Facilities	4,208,905
Right-of-Way	5,458,500
3. ENGINEERING AND CONSTRUCTION SUPPORT	1,397,744
4. PROJECT ADMINISTRATION	581,711
5. FORCE ACCOUNT	145,265
6. CONTINGENCY	2,850,618
TOTAL COST (1993$)	$30,752,267

TABLE 2-14: MBTA CAPITAL COST ESTIMATE FOR TRANSITWAY MOS-1 ALTERNATIVE HIGH GROWTH SCENARIO

Item		Cost
1.	TRANSITWAY STRUCTURE	
	Turnaround loop and line section from Essex Street to 200 feet south of Congress Street — CC01	$24,731,000
	Line section from 200 feet south of Congress Street to Congress Street — CC02A	1,680,000
	Line section from Congress Street to the west end of the channel crossing — Russia Wharf alignment — CC03A	14,010,000
	Fort Point Channel crossing, including portal to surface and surface station — CC05	43,020,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC01, CC02A, CC03A, CC05, and CC15 (excluding South Station finishes) — CC06	7,250,000
	South Station reconstruction with station finishes — CC15	36,000,000
2.	SYSTEMWIDE ELEMENTS	
	Power & Catenary — CC12	25,256,100
	Signals & Communication — CC13	5,932,800
	Vehicles	50,174,600
	Maintenance Facility — CC14	29,003,000
	Right-of-Way	5,075,000
3.	ENGINEERING AND CONSTRUCTION SUPPORT	20,199,300
4.	PROJECT ADMINISTRATION	7,927,200
5.	FORCE ACCOUNT	1,068,900
6.	CONTINGENCY	12,615,200
	TOTAL COST (1993$)	$283,943,100

TABLE 2-15: MBTA CAPITAL COST ESTIMATE FOR TRANSITWAY MOS-1 ALTERNATIVE LOWER GROWTH SCENARIO

	Item	Cost
1.	TRANSITWAY STRUCTURE	
	Turnaround loop and line section from Essex Street to 200 feet south of Congress Street — CC01	$24,731,000
	Line section from 200 feet south of Congress Street to Congress Street — CC02A	1,680,000
	Line section from Congress Street to the west end of the channel crossing — Russia Wharf alignment — CC03A	14,010,000
	Fort Point Channel crossing including portal to surface and surface station — CC05	43,020,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC01, CC02A, CC03A, CC05, and CC15 (excluding South Station finishes) — CC06	7,250,000
	South Station reconstruction with station finishes — CC15	36,000,000
2.	SYSTEMWIDE ELEMENTS	
	Power & Catenary — CC12	25,256,100
	Signals & Communication — CC13	5,932,800
	Vehicles	28,290,600
	Maintenance Facility — CC14	14,211,500
	Right-of-Way	5,075,000
3.	ENGINEERING AND CONSTRUCTION SUPPORT	18,282,500
4.	PROJECT ADMINISTRATION	7,123,600
5.	FORCE ACCOUNT	1,068,900
6.	CONTINGENCY	11,136,000
	TOTAL COST (1993$)	$243,068,000

TABLE 2-16: MBTA CAPITAL COST ESTIMATE FOR TRANSITWAY MOS-2 ALTERNATIVE HIGH GROWTH SCENARIO

Item		Cost
1.	TRANSITWAY STRUCTURE	
	Turnaround loop and line section from Essex Street to 200 feet south of Congress Street — CC01	$24,731,000
	Line section from 200 feet south of Congress Street to Congress Street — CC02A	1,680,000
	Line section from Congress Street to the west end of the channel crossing — Russia Wharf alignment — CC03A	14,010,000
	Fort Point Channel crossing — CC05	24,600,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC01, CC02A, CC03A, CC05, and CC15 (excluding South Station finishes) — CC06	6,650,000
	Courthouse Station with station finishes — CC07	31,300,000
	Line section from the east end of the channel crossing at Sleeper Street to New Congress Street (excluding Courthouse Station) — CC08	20,995,000
	World Trade Center Station with station finishes, and including line section from New Congress Street to D Street — CC09	24,500,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC08 and CC07 (excluding Courthouse Station finishes) — CC10	5,714,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC09 (excluding World Trade Center Station finishes) — CC11	960,000
	South Station reconstruction with station finishes — CC15	36,000,000
2.	SYSTEMWIDE ELEMENTS	
	Power & Catenary — CC12	25,256,100
	Signals & Communication — CC13	6,432,800
	Vehicles	50,174,600
	Maintenance Facility — CC14	29,003,000
	Right-of-Way	24,374,500
3.	ENGINEERING AND CONSTRUCTION SUPPORT	28,624,100
4.	PROJECT ADMINISTRATION	11,170,800
5.	FORCE ACCOUNT	1,068,900
6.	CONTINGENCY	19,110,100
	TOTAL COST (1993$)	$386,354,900

TABLE 2-17: MBTA CAPITAL COST ESTIMATE FOR TRANSITWAY MOS-2 ALTERNATIVE LOWER GROWTH SCENARIO

	Item	Cost
1.	TRANSITWAY STRUCTURE	
	Turnaround loop and line section from Essex Street to 200 feet south of Congress Street — CC01	$24,731,000
	Line section from 200 feet south of Congress Street to Congress Street — CC02A	1,680,000
	Line section from Congress Street to the west end of the channel crossing — Russia Wharf alignment — CC03A	14,010,000
	Fort Point Channel crossing — CC05	24,600,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC01, CC02A, CC03A, CC05, and CC15 (excluding South Station finishes) — CC06	6,650,000
	Courthouse Station with station finishes — CC07	31,300,000
	Line section from the east end of the channel crossing at Sleeper Street to New Congress Street (excluding Courthouse Station) — CC08	20,995,000
	World Trade Center Station with station finishes, and including line section from New Congress Street to D Street — CC09	24,500,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC08 and CC07 (excluding Courthouse Station finishes) — CC10	5,714,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC09 (excluding World Trade Center Station finishes) — CC11	960,000
	South Station reconstruction with station finishes — CC15	36,000,000
2.	SYSTEMWIDE ELEMENTS	
	Power & Catenary — CC12	25,256,100
	Signals & Communication — CC13	6,432,800
	Vehicles	28,290,600
	Maintenance Facility — CC14	14,211,500
	Right-of-Way	24,374,500
3.	ENGINEERING AND CONSTRUCTION SUPPORT	26,707,300
4.	PROJECT ADMINISTRATION	10,367,200
5.	FORCE ACCOUNT	1,068,900
6.	CONTINGENCY	17,630,900
	TOTAL COST (1993$)	$345,479,800

TABLE 2-18: MBTA CAPITAL COST ESTIMATE FOR TRANSITWAY FULL BUILD ALTERNATIVE - HIGH GROWTH SCENARIO

Item		Cost
1.	TRANSITWAY STRUCTURE	
	Turnaround loop and line section from Essex Street to 200 feet south of Congress Street — CC01	$24,731,000
	Line section from 200 feet south of Congress Street to Congress Street — CC02A	1,680,000
	Line section from Congress Street to the west end of the channel crossing — Russia Wharf alignment — CC03A	14,010,000
	Line section along Essex Street from South Station to Atlantic Avenue	13,780,000
	Fort Point Channel crossing — CC05	24,600,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC01, CC02A, CC03A, CC05, and CC15 (excluding South Station finishes) — CC06	6,650,000
	Courthouse Station with station finishes — CC07	31,300,000
	Line section from the east end of the channel crossing at Sleeper Street to New Congress Street (excluding Courthouse Station) — CC08	20,995,000
	World Trade Center Station with station finishes, and including line section from New Congress Street to D Street — CC09	24,500,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC08 and CC07 (excluding Courthouse Station finishes) — CC10	5,714,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC09 (excluding World Trade Center Station finishes) — CC11	960,000
	South Station reconstruction with station finishes — CC15	36,000,000
	Mined tunnel line section from east end of Chinatown Station to South Street — CC21	41,224,000
	Line section from Tremont Street to east end of Chinatown Station, including Chinatown Station and station finishes — CC22	28,319,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC22 (excluding Chinatown Station finishes), CC21, and CC04 — CC23	5,232,000
	Boylston Station turnaround with Boylston Station finishes, architectural tunnel finishes, tunnel mechanical and electrical, signals, and communication and power and catenary — CC27	48,611,000
2.	SYSTEMWIDE ELEMENTS	
	Power & Catenary — CC12 and CC24	41,005,100
	Signals & Communication — CC13 and CC25	11,497,800
	Vehicles	62,500,000
	Maintenance Facility — CC14	29,003,000
	Right-of-Way	25,466,100
3.	ENGINEERING AND CONSTRUCTION SUPPORT	44,777,800
4.	PROJECT ADMINISTRATION	17,426,900
5.	FORCE ACCOUNT	2,542,900
6.	CONTINGENCY	34,908,100
	TOTAL COST (1993$)	$597,433,700

TABLE 2-19: MBTA CAPITAL COST ESTIMATE FOR TRANSITWAY FULL BUILD ALTERNATIVE - LOWER GROWTH SCENARIO

Item		Cost
1.	TRANSITWAY STRUCTURE	
	Turnaround loop and line section from Essex Street to 200 feet south of Congress Street — CC01	$24,731,000
	Line section from 200 feet south of Congress Street to Congress Street — CC02A	1,680,000
	Line section from Congress Street to the west end of the channel crossing — Russia Wharf alignment — CC03A	14,010,000
	Line section along Essex Street from South Station to Atlantic Avenue	13,780,000
	Fort Point Channel crossing — CC05	24,600,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC01, CC02A, CC03A, CC05, and CC15 (excluding South Station finishes) — CC06	6,650,000
	Courthouse Station with station finishes — CC07	31,300,000
	Line section from the east end of the channel crossing at Sleeper Street to New Congress Street (excluding Courthouse Station) — CC08	20,995,000
	World Trade Center Station with station finishes, and including line section from New Congress Street to D Street — CC09	24,500,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC08 and CC07 (excluding Courthouse Station finishes) — CC10	5,714,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC09 (excluding World Trade Center Station finishes) — CC11	960,000
	South Station reconstruction with station finishes — CC15	36,000,000
	Mined tunnel line section from east end of Chinatown Station to South Street — CC21	41,224,000
	Line section from Tremont Street to east end of Chinatown Station, including Chinatown Station and station finishes — CC22	28,319,000
	Architectural tunnel finishes and tunnel mechanical and electrical for CC22 (excluding Chinatown Station finishes), CC21, and CC04 — CC23	5,232,000
	Boylston Station turnaround with Boylston Station finishes, architectural tunnel finishes, tunnel mechanical and electrical, signals, and communication and power and catenary — CC27	48,611,000
2.	SYSTEMWIDE ELEMENTS	
	Power & Catenary — CC12 and CC24	41,005,100
	Signals & Communication — CC13 and CC25	11,497,800
	Vehicles	37,368,800
	Maintenance Facility — CC14	14,211,500
	Right-of-Way	25,466,100
3.	ENGINEERING AND CONSTRUCTION SUPPORT	42,796,100
4.	PROJECT ADMINISTRATION	16,588,600
5.	FORCE ACCOUNT	2,542,900
6.	CONTINGENCY	33,428,900
	TOTAL COST (1993$)	$553,211,800

TABLE 2-20: SUMMARY OF MBTA CAPITAL COST ESTIMATES

Alternative	Capital Costs (Millions of 1993 Dollars)	
	Lower Growth Scenario	High Growth Scenario
No Action	$7.6	$7.6
Bus/TSM	$30.8	$59.8
Transitway MOS-1	$243.1	$284.0
Transitway MOS-2	$345.5	$386.4
Transitway Full Build	$553.2	$597.4

TABLE 2-21: NO ACTION ALTERNATIVE OPERATING AND MAINTENANCE COSTS

Cost Category	*Annual Cost*	*Staff Requirement*
Lower Growth Scenario		
Transportation	*$2,748,375*	*44.6*
Equipment	*868,350*	*11.7*
Way and Structures	*463,050*	*5.6*
Administrative	*246,225*	*2.8*
TOTAL	*$4,326,000*	*64.7*
High Growth Scenario		
Transportation	*$2,748,375*	*44.6*
Equipment	*868,350*	*11.7*
Way and Structures	*463,050*	*5.6*
Administrative	*246,225*	*2.8*
TOTAL	*$4,326,000*	*64.7*

TABLE 2-22: BUS/TSM ALTERNATIVE OPERATING AND MAINTENANCE COSTS

Cost Category	Annual Cost	Staff Requirement
Lower Growth Scenario		
Transportation	*$6,810,541*	*105.9*
Equipment	*1,957,488*	*24.8*
Way and Structures	*1,060,275*	*11.9*
Administrative	*602,825*	*6.6*
TOTAL	*$10,431,129*	*149.2*
High Growth Scenario		
Transportation	*$11,192,100*	*176.0*
Equipment	*5,226,500*	*65.0*
Way and Structures	*2,032,900*	*21.8*
Administrative	*1,142,000*	*12.7*
TOTAL	*$19,593,500*	*275.4*

TABLE 2-23: TRANSITWAY MOS-1 ALTERNATIVE OPERATING AND MAINTENANCE COSTS

Cost Category	Annual Cost	Staff Requirement
Lower Growth Scenario		
Transportation	*$9,205,804*	*140.5*
Equipment	*2,399,024*	*34.7*
Way and Structures	*1,937,960*	*21.8*
Administrative	*673,653*	*7.5*
TOTAL	*$14,216,441*	*204.6*
High Growth Scenario		
Transportation	*$15,820,155*	*237.6*
Equipment	*5,189,402*	*72.3*
Way and Structures	*3,133,747*	*34.8*
Administrative	*1,267,431*	*14.4*
TOTAL	*$25,410,735*	*359.0*

TABLE 2-24: TRANSITWAY MOS-2 ALTERNATIVE OPERATING AND MAINTENANCE COSTS

Cost Category	Annual Cost	Staff Requirement
Lower Growth Scenario		
Transportation	*$9,399,485*	*143.9*
Equipment	*2,365,534*	*33.9*
Way and Structures	*2,267,572*	*25.4*
Administrative	*659,316*	*7.4*
TOTAL	*$14,691,907*	*210.5*
High Growth Scenario		
Transportation	*$15,744,703*	*236.8*
Equipment	*5,088,105*	*69.9*
Way and Structures	*3,428,728*	*37.9*
Administrative	*1,239,934*	*14.1*
TOTAL	*$25,501,470*	*358.7*

TABLE 2-25: TRANSITWAY FULL BUILD ALTERNATIVE OPERATING AND MAINTENANCE COSTS

Cost Category	Annual Cost	Staff Requirement
Lower Growth Scenario		
Transportation	*$9,205,665*	*138.4*
Equipment	*1,791,031*	*30.4*
Way and Structures	*2,757,063*	*27.8*
Administrative	*461,386*	*5.2*
TOTAL	*$14,215,145*	*201.8*
High Growth Scenario		
Transportation	*$16,157,212*	*239.3*
Equipment	*4,746,775*	*71.0*
Way and Structures	*4,068,109*	*40.8*
Administrative	*1,062,528*	*12.2*
TOTAL	*$26,034,624*	*363.3*

TABLE 2-26: SUMMARY OF O&M COSTS AND STAFFING BY ALTERNATIVE

Alternative	Total Annual O&M Cost	Staffing Requirement
Lower Growth Scenario		
No Action	$4,326,000	64.7
Bus/TSM	$10,431,129	149.2
Transitway MOS-1	$14,216,441	204.6
Transitway MOS-2	$14,691,907	210.5
Transitway Full Build	$14,215,145	201.8
High Growth Scenario		
No Action	$4,326,000	64.7
Bus/TSM	$20,152,513	275.4
Transitway MOS-1	$25,410,739	359.0
Transitway MOS-2	$25,501,470	358.7
Transitway Full Build	$26,034,624	363.3

2.6 THE LOCALLY PREFERRED ALTERNATIVE

The locally preferred alternative for the South Boston Piers/Fort Point Channel Transit Project, selected as the result of the DEIS/SDEIR process, is the Fort Point Channel Underground Transitway Full Build Alternative. The Full Build Alternative represents the optimization of both a fixed guideway and bus solution to serving future growth in trip demand generated by new development in the South Boston Piers area. A 1.5-mile underground transit tunnel from Boylston Station to the World Trade Center combined with surface bus operations on streets where congestion is projected to be minimal will link this new development with regional mass transit services in downtown Boston. Five underground Transitway stations and numerous surface bus stations will provide connections to the Red, Orange, and Green Lines as well as commuter and intercity rail and bus services.

Trackless trolleys will be operated in the Transitway tunnel and on two surface routes in the easternmost portion of the Piers area and on a third route to residential South Boston. Conventional buses will supplement this service on surface streets. A storage and maintenance facility will be constructed to accommodate a fleet of up to 166 vehicles, 53 of which will be articulated trackless trolleys.

Construction of the Full Build Alternative will be staged. The initial phase is MOS-2, the tunnel segment from South Station to the World Trade Center with three underground Transitway stations at South Station, the new Federal Courthouse/Fan Pier, and the World Trade Center. This phase is expected to be operational in the year 2000. The second phase of the project — the tunnel from South Station to Boylston Station — is scheduled to be open for revenue service by 2008. Between

1998 and opening of the first phase of the project in 2000, interim bus service will be operated to serve existing and near-term development in the Piers area. Additional details about the locally preferred alternative's physical and operating characteristics are provided above in Section 2.3.3. The sections that follow describe the rationale for selection of the locally preferred alternative, coordination with other infrastructure and development projects, and a project schedule. Section 2.7 provides an interim bus service plan for operation prior to opening of the first phase of the Transitway project.

2.6.1 Rationale for Selection of the Locally Preferred Alternative

The locally preferred alternative for the South Boston Piers/Fort Point Channel Transit Project has been selected based on a rigorous screening process that began in 1987 with a feasibility study, was continued in the DEIR phase of the project, and culminated in the preparation of the DEIS/SDEIR. From the project's inception, a broad set of alternatives was gradually narrowed based on analysis of the alternatives' transportation, environmental, and financial impacts. A brief description of this screening process was presented in Section 2.2.

A key component of the screening process has been the involvement of private citizens and federal, state, and local agencies. Numerous public meetings have been held throughout the project's history, and most recently, a public hearing was held to take testimony and written comments on the DEIS/SDEIR. These comments, as well as comments on the earlier DEIR, are addressed in the separately bound Response to Comments Appendix. Based on the screening process and the public involvement program, the MBTA has selected the Fort Point Channel Underground Transitway Full Build Alternative as the locally preferred alternative.

Three evaluation criteria were developed to provide a framework for selecting the locally preferred alternative: (1) financial feasibility, the ability of known funding sources to meet anticipated capital and operating funding requirements; (2) effectiveness, the degree to which the alternatives assist in the attainment of transportation and other planning goals; and (3) cost-effectiveness, the cost associated with achieving the benefits of each alternative. Since all alternatives were found to be financially feasible in the DEIS/SDEIR, this criteria was not used to distinguish among alternatives. The rationale for selection of the locally preferred alternative is discussed in terms of the effectiveness and cost-effectiveness criteria presented below.

2.6.1.1 Effectiveness

Using regional planning goals as a basis, the MBTA established several goals specific to the South Boston Piers/Fort Point Channel Transit Project. These goals, which are shown in Chapter 1, Section 1.6, were developed through an extensive interagency and community participation process and provided a basis for evaluating the effectiveness of alternative improvements to transportation services and facilities in the South Boston Piers area.

The Full Build Transitway was shown to outperform all alternatives in terms of each project goal:

- *Under the Full Build Alternative, transit ridership and mode share to the Piers area would be the highest of all alternatives analyzed. The Full Build Alternative would attract a 62 percent transit mode share in the a.m. peak hour, and the daily mode share would be only 2 percentage points lower than that projected for downtown Boston.*

- *Since the travel time from the regional transit system to the Piers area in the Full Build Alterative would be equal or better than that under any other alternative, and given the free underground transfers to the Transitway offered at three of the four MBTA rapid transit lines, the Full Build Alternative offers maximal time and fare benefits to users.*

- *Less than 3 percent of all trips to the Piers area are comprised of walking across the Fort Point Channel into the Piers area, fewer than in any other alternative. This is an important user convenience benefit.*

- *As evidenced by the increase in the number of non-Piers area riders using the Transitway tunnel services in comparison to services in the other alternatives, the Full Build Alternative is unique in its ability to benefit other transit riders in the region.*

- *The Full Build Alternative is the only alternative analyzed that can fully support the 2010 development goals for the South Boston Piers area of 21.7 million square feet.*

- *The significant improvements in on-street conditions afforded by the Full Build Alternative include a reduction of 11,000 automobile trips each day; the highest vehicle operating speeds of any alternative analyzed; operation of all signalized intersections at level of service D or better; and a nearly 55 percent reduction in the maximum average intersection delay over the No Action Alternative. As compared to the Bus/TSM Alternative, the Full Build Alternative also achieves the greatest reduction of daily vehicle miles traveled (VMT) at over 300,000.*

- *The Full Build Alternative contributes most to the cohesiveness of existing neighborhoods, since construction of an underground Transitway tunnel from Boylston Station to the World Trade Center will substantially reduce vehicular traffic on surface streets.*

- *The Full Build Alternative would produce the most passenger miles in exclusive, weather-protected right-of-way of any alternative analyzed. This is an important measure of service reliability.*

- *The Full Build Alterative is the most productive of any of the alternatives analyzed, serving over 50 percent more passengers per vehicle hour or over 25 percent more passengers per vehicle mile than the next best performing alternative.*

2.6.1.2 Cost-Effectiveness

The Full Build Alternative is the most cost-effective alternative analyzed according to both the new trip index and the user benefit index.[4] Thus, despite being the most expensive alternative to implement, these indices show that the benefits afforded by the Full Build Alternative outweigh its costs in comparison to the other alternatives analyzed. Additional information on cost-effectiveness is provided in Chapter 6, Section 6.4.

2.6.2 Project Schedule

The construction schedule for each section of the project is detailed in Table 2-27 and shown in Figure 2-18. Construction contracts needed to complete the initial phase of the project — MOS-2 — are CC01 through CC15. As noted above, the first phase of the project — the Transitway tunnel from South Station to the World Trade Center — is scheduled to be open for revenue service in the year 2000. The second phase — extension of the Transitway tunnel westward to Boylston Station — is scheduled for opening of revenue service by 2008.

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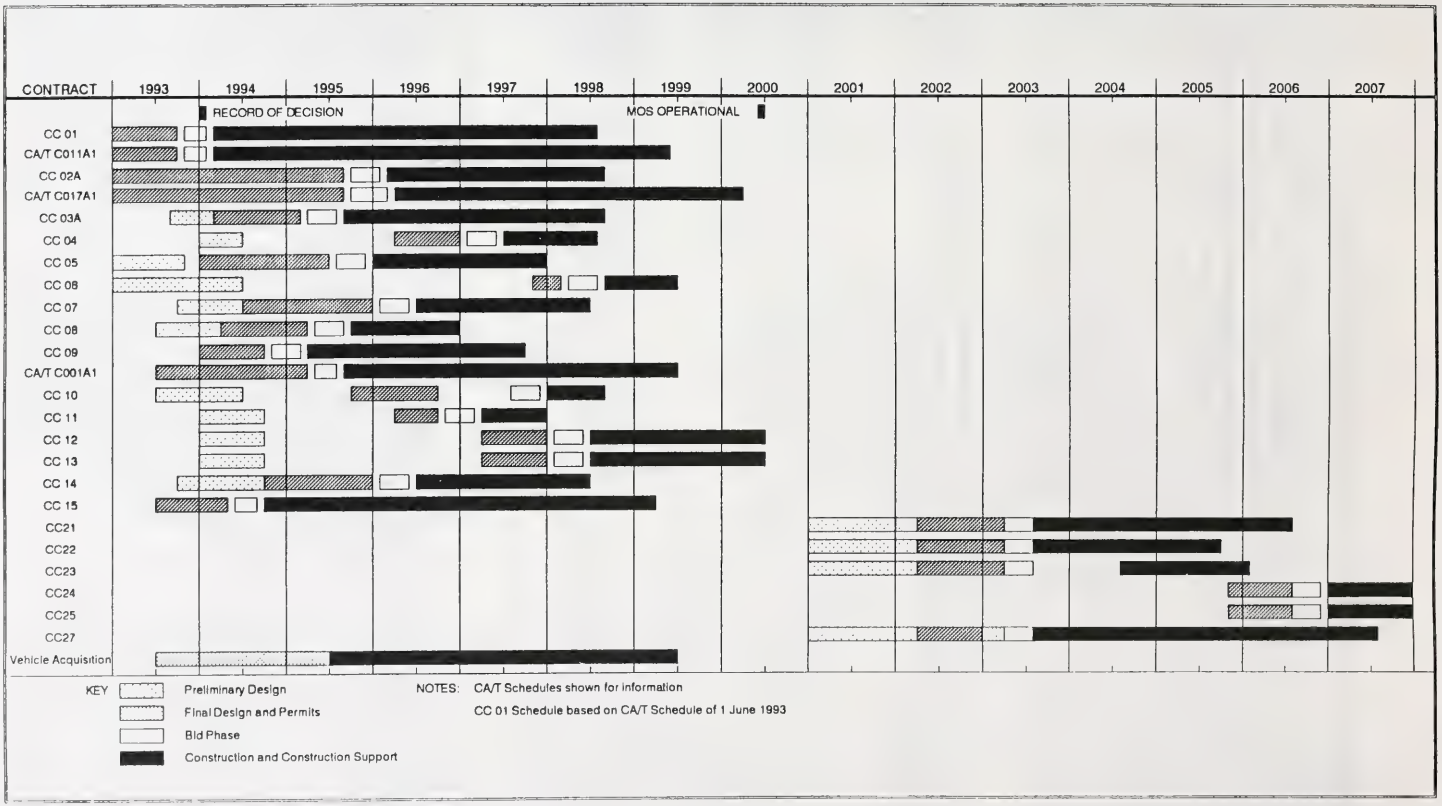
[4] *The new trip index measures the additional capital and operating cost per new passenger attracted to the transit improvement as compared to the Bus/TSM Alternative. The user benefit index relates the costs of building and operating an alternative with the user benefits (e.g., time and cost savings) accruing from that alternative.*

TABLE 2-27: CONSTRUCTION SCHEDULE FOR THE FULL BUILD TRANSITWAY

Construction Contract	Contract Description	Begin Year	End Year
CC01	Turnaround loop and line sections from Essex Street to 200 feet south of Congress Street (excluding South Station reconstruction)	1994	1998
CC02A	Line section from 200 feet south of Congress Street to Congress Street	1996	2000
CC03A	Line section from Congress Street to the west end of the channel crossing — Russia Wharf alignment	1995	1998
CC04	Line section along Essex Street from South Street to Atlantic Avenue	1997	1998
CC05	Fort Point Channel Crossing	1996	1997
CC06	Architectural tunnel finishes, and tunnel mechanical and electrical for CC01, CC02A, CC03A, CC05, and CC15 (excluding South Station finishes)	1998	1999
CC07	Courthouse Station with station finishes	1996	1998
CC08	Line section from the east end of the channel crossing at Sleeper Street to New Congress Street (excluding Courthouse Station)	1995	1996
CC09	World Trade Center Station with station finishes and including line sections from New Congress Street to D Street	1995	1997
CC10	Architectural tunnel finishes and tunnel and mechanical and electrical for CC08 and CC07 (excluding Courthouse Station finishes)	1998	1998
CC11	Architectural tunnel finishes and tunnel mechanical and electrical for CC09 (excluding World Trade Center Station finishes)	1997	1997
CC12	Power and catenary for MOS-2	1998	2000
CC13	Signals and communication for MOS-2	1998	2000
CC14	Maintenance facility	1996	1998
CC15	South Station reconstruction and station finishes	1994	1999
CC21	Mined tunnel line section from the east end of Chinatown Station to South Street	2003	2006
CC22	Line section from Tremont Street to the east end of Chinatown Station and finishes	2003	2005
CC23	Architectural tunnel finishes and tunnel mechanical and electrical for CC22 (excluding Chinatown Station finishes)	2004	2006
CC24	Power and catenary for Full Build extension — CC22, CC21, and CC04	2007	2007
CC25	Signals and communication for Full Build extension — CC22, CC21, and CC04	2007	2007
CC27	Boylston Station turnaround with Boylston Station finishes, architectural tunnel finishes, tunnel mechanical and electrical, signals and communications, and power and catenary	2003	2007



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-18
Transitway Construction Schedule

2.6.3 Coordination with Other Infrastructure and Development Projects

The MBTA has maintained close coordination with the proponents of other public and private projects throughout the planning and design phases of the transit project. Identification of joint construction opportunities has been and remains a major goal of the coordination efforts. Joint construction opportunities that have been identified and pursued to date include the Transitway tunnel, turnaround loop, and utilities relocation in Dewey Square with the northbound Central Artery beneath Atlantic Avenue to Congress Street (CA/T Project construction contracts C11A1 and C17A1); Transitway platforms at South Station will be incorporated into the C11A1 contract pending receipt of a Record of Decision on this FEIS/FEIR and identification of funding sources. The MBTA will also coordinate the Transitway tunnel and the Seaport Access Road Ramp F (C1A1), and is working with MHD to coordinate construction of a portion of the Transitway tunnel beneath a corner of the CA/T Project's Material Processing Operation (C21B1). An agreement has been established between the MBTA and MHD detailing the agencies' responsibilities and commitments for the C11A1 construction contract which was advertised on November 3, 1993.

The MBTA has also worked closely with the developers of privately-owned parcels abutting the alignment between Courthouse Station and New Congress Street to limit impacts of the Transitway on future development. Design of the World Trade Center Station has been coordinated with Massport's Replacement Parking Garage at Commonwealth Flats.

In midtown, the MBTA will continue to pursue joint construction opportunities, particularly with future developers of the Hayward parcel (bounded by Hayward Place, Washington Street, Avenue de Lafayette, and Harrison Avenue) and Parcel 30/Keith Block (bounded by Boylston, Tremont, Avery, and Washington Streets). At present, no immediate plans for these two parcels have been made public, and final design of the midtown section of the transit project will not occur for several years. However, the MBTA is designing its Transitway station beneath the Hayward parcel to accommodate a future 400-foot building on the site, and will coordinate the station with future activities on the Hayward parcel and Parcel 30.

The construction schedule for the Transitway has been closely coordinated and integrated with the CA/T Project schedule. Table 2-28 shows the relationship and schedule of Transitway and CA/T construction contracts. Construction of the first phase of the Transitway project is scheduled to begin in 1994.

2.7 INTERIM BUS SERVICE PLAN

The South Boston Piers Transitway is envisioned both as the primary transit line serving the developing Piers area and as a critical element in shaping a new urban environment. As a result, the MBTA is working toward timely implementation of the service prior to large scale development of the area. Nevertheless, since some key segments of the transit project must await completion of portions of the CA/T Project along Atlantic Avenue, the first phase of the Transitway will not be opened until the year 2000. As a result, it is expected the some new development in the area will take place prior to the opening of Transitway service. In particular, the new Federal Courthouse and the World Trade Center hotel are projected to open by 1998. In response to progress on these developments, the MBTA will operate expanded bus service in the interim period between the Courthouse opening in 1998 and the opening of the Transitway initial implementation phase (MOS-2) from South Station to the World Trade Center in 2000. The interim bus plan described in this section addresses the necessary bus service expansion.

TABLE 2-28: RELATIONSHIP OF TRANSITWAY AND CA/T CONSTRUCTION SCHEDULES

Transitway Construction Contract	Related CA/T Construction Contract	Transitway Construction Contract Description	Contract Start	Contract End
CC01	C11A1	Turnaround loop and line sections from Essex Street to 200 feet south of Congress Street	1994	1998
CC15	C11A1	South Station reconstruction with station finishes (included in CA/T contract pending receipt of a Record of Decision and identification of funding	1994	1999
CC02A	C17A1	Line section 200 feet south of Congress Street to Congress Street	1996	1998
CC09	C1A1	World Trade Center Station with station finishes, including the line segment from New Congress Street to D Street; construction of the station will also be coordinated with Massport's Replacement Parking Garage	1995	1997

The goal of the interim bus service detailed below is to serve existing and new transit demand in the Piers area. It will begin the process of transforming the present transit service into the MOS-2, and ultimately Full Build, Transitway service plan. As such, the interim service can help build a strong ridership base for the Transitway. The present Piers area transit service is described in Chapter 3, Section 3.3.1.1. The following sections describe the changes in the Piers area street system for 1998, the required bus service changes, 1998 Piers area transit demand, the options analyzed to serve that demand, and finally, details of the selected plan.

2.7.1 Interim Year Piers Area Street System

As a result of the CA/T Project and City of Boston roadway improvement projects, the South Boston Piers area street system will be significantly changed by 1998. Some street system changes have already been made to accommodate Third Harbor Tunnel and New Northern Avenue bridge construction. By 1998, additional street changes are projected in two relatively distinct areas: 1) the area around New Northern Avenue, and 2) the Seaport Access Road and South Boston Interchange area.

By 1998, the New Northern Avenue bridge will replace the current Northern Avenue bridge. Northern Avenue traffic will be re-routed to New Northern Avenue with Northern Avenue remaining for local access to Fan Pier and Pier 4 developments. (Northern Avenue will be one-way westbound between Pittsburgh and Sleeper Streets.) Sleeper Street, which has been closed during bridge construction, will be restored and made one-way southbound, while Pittsburgh Street will be extended to Northern Avenue and made one-way northbound. (Farnsworth and Stillings Streets will remain as dead end streets.) East of Stillings Street, the West Service Road will be constructed between New Northern Avenue and Congress Street and will also be one-way northbound. The recently constructed East Service Road, which is directly opposite Northern Avenue at the intersection of New Northern Avenue, will become one-way southbound. (This road is now used

by MBTA Routes 6 and 7 as a replacement for Sleeper Street.) B Street will remain between Congress Street and Northern Avenue but is expected to remain unimproved in 1998.

The South Boston Bypass Road (part of the CA/T Project) has been completed and is now open to commercial traffic between Dorchester Avenue and Congress Street. It meets Congress Street opposite the new East Service Road. By 1998, Congress Street, east of the West Service Road, will be relocated slightly northward to avoid Seaport Access Road construction. Summer Street, in the vicinity of its viaduct over the Bypass Road and B and C Streets will also be relocated northward. The section of B Street passing under the Summer Street viaduct and connecting to Fargo Street, used by one variation of MBTA Route 7, will be closed. Viaduct and Ramp Streets, which connect Summer Street to the World Trade Center and Northern Avenue, will also be closed for reconstruction. These two streets are used by all three MBTA routes in the area. Congress Street will be extended to meet an extension of D Street that will connect the two currently unconnected parts of D Street. A temporary connection to the upper level of the World Trade Center will be constructed from the Congress Street extension. Opposite Congress Street at the intersection with D Street will be temporary connections to the Third Harbor Tunnel, which will be open for commercial traffic only. Finally, the section of the Massport Haul Road east of D Street will be restored but open only to eastbound traffic.

There will also be changes on the downtown side of the Fort Point Channel that will affect MBTA service to the Piers area. Improvements to the Summer Street bridge are expected to remove the remaining weight restrictions on that facility. Mainline Central Artery construction will also require changes in downtown street patterns. Most notable for MBTA service, Atlantic Avenue (used by Route 6 northbound) will be restricted in width at several points. To provide additional northbound capacity, High Street (used by Route 6 southbound) will be reversed and become one-way northbound, with southbound traffic relocated to Purchase Street.

2.7.2 Bus Route Changes Required by Interim Year Street Changes

The roadway changes outlined above will force changes to MBTA service in the Piers area and will provide some new opportunities for bus service changes. Possible MBTA responses to these roadway changes are summarized below. These possibilities, along with the transit needs of new development in the area, were taken into account in developing the Interim Bus Service Plan outlined in Section 2.7.5.

Viaduct Street and Ramp Streets, which will both be closed by 1998, are currently used by MBTA Routes 3, 6, and 7 to travel between Summer Street and Northern Avenue. At one time, Routes 6 and 7 used Summer Street directly from downtown, but weight restrictions on the Summer Street bridge and viaduct forced a relocation of part of the service to Viaduct Street, Northern Avenue, and Sleeper Street. The recent closing of Sleeper Street and the opening of the East Service Road forced service to be relocated once again. Instead of this route, some peak period trips on Route 7 use D, Fargo, and B Streets. With the closing of this portion of B Street, this movement will no longer be possible.

The roadway improvements and extensions planned for 1998 leave several opportunities for replacing the current Route 6 and 7 alignments. The routes could continue to use Northern Avenue, accessing it via the new D Street; they could use the temporary extended Congress Street from D Street; or they could use the relocated Summer Street and renovated Summer Street bridge to take the most direct route downtown. Current ridership data indicates the need to provide service between the World Trade Center and downtown[5], and between the Congress and Sleeper Street area and residential South Boston. Thus, new D Street and Northern Avenue would be the most

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[5] The vast majority of transit users at the World Trade Center use the privately operated shuttle bus services funded by the World Trade Center and its prime tenant.

appropriate route with the connection to Congress Street made either via the East and West Service Roads or via Sleeper and Pittsburgh Streets.

MBTA Route 3 also uses the Viaduct and Ramp Street connection as well as the B and Fargo Street connection, both of which will be eliminated by 1998. Route 3 could be re-routed to the new temporary Congress Street, Northern Avenue (via the East and West Service Roads), or the relocated Summer Street (via Melcher Street) to reach the new extended D Street. As an alternative to the current A Street alignment, the newly opened South Boston Bypass Road could be used, accessed from Dorchester Avenue near the MBTA's Cabot Yard. This would allow connections only to Northern Avenue or Congress Street, and not Summer Street. With virtually no passenger activity along this section of the route, the new Bypass Road and Congress Street appear to be able to offer the best service for riders.

Access to BMIP, which is served directly by both Routes 3 and 6, would not be substantially impacted in 1998. Changes to Routes 3 and 6, however, raise some issues about the way bus service is provided to BMIP and the Summer Street area. The current large one-way loop has virtually no passenger activity along Viaduct, Ramp, D Street, and Northern Avenue, while the high activity stops along Summer Street are served only in the inbound direction on Route 6 and would be served similarly with a revised Route 3. Therefore, a smaller BMIP loop, with two-way service along Summer Street to the Harbor Street BMIP entrance, appears to be the best service configuration.

2.7.3 Interim Year Travel Demand

Two major changes in Piers area development are anticipated by the 1998 interim year. These are the new Federal Courthouse on Fan Pier and the World Trade Center Hotel on Northern Avenue, immediately east of Viaduct Street. These two developments, especially the Courthouse, are projected to generate a significant number of new transit trips. Overall trip-making and transit ridership from existing developments are not expected to change substantially from today's levels.

2.7.3.1 Current Piers Area Transit Ridership

The most heavily patronized transit service to the Piers area is the privately operated shuttle service between South Station and the World Trade Center, which carries approximately 380 riders in the a.m. peak hour. (Three other shuttle services to the World Trade Center also attract considerable ridership but are open only to employees of the prime tenant at the World Trade Center.) It is assumed that these services will remain in place until the Transitway is completed.

The most recent detailed ridership data for MBTA routes is from 1990; however, more recent less detailed data indicate that ridership has not increased, and may have declined slightly between 1990 and 1993. With the current level of development, parking is still cheap and plentiful despite the parking freeze. The two new developments are projected to make the Fan Pier and New Northern Avenue area parking lots more heavily utilized, but parking capacity is not projected to be exceeded in 1998[6]. Thus, without any significant decrease in the availability of low cost parking, transit ridership from existing Piers area development is not expected to increase above 1990 levels by 1998.

MBTA 1990 daily, a.m. peak period, and estimated a.m. peak hour eastbound ridership across the Fort Point Channel (or Dorchester Avenue) is shown in Table 2-29 for the three Piers area routes. (As noted above, these ridership levels are expected to remain stable through 1998, excluding

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[6] The Courthouse EIS estimates that Courthouse auto trips will fill the adjacent underutilized parking lot to within 70 vehicles of capacity (1,600 cars in a 1,670 space lot). If the high transit shares detailed in the following section are not realized, then this lot can be expected to fill to capacity. Other slightly less convenient parking lots would still have sufficient capacity.

ridership to new developments.) Virtually all eastbound a.m. peak riders on these three routes have destinations in the Piers area. Route 7 also serves trips through the Piers area to residential South Boston, however, in the eastbound direction, these tend to occur mostly in the p.m. peak.

TABLE 2-29: RIDERSHIP ON MBTA ROUTES SERVING THE PIERS AREA

MBTA Bus Route	Daily	A.M. Peak Period	A.M. Peak Hour
Route 3	130	129	65
Route 6	368	361	181
Route 7	1,769	315	158

2.7.3.2 Federal Courthouse Transit Demand

The new Federal Courthouse planned for Fan Pier would significantly increase travel to the Piers area. The Environmental Impact Statement for the Courthouse[7] includes estimates of 1997 travel to the Courthouse by mode and category of trip (employee, juror, and visitor), summarized in Table 2-30.

TABLE 2-30: COURTHOUSE EIS DEMAND ESTIMATE

	Daily			A.M. Peak Hour		
Category	Trips	Transit	Transit Share	Trips	Transit	Transit Share
Employees	816	661	81%	555	450	81%
Jurors	200	100	50%	200	100	50%
Visitors	2,211	376	17%	304	52	17%
Total	3,227	1,137	35%	1,059	602	57%

The transit share estimates are based on a survey of employees and visitors at the current Federal Courthouse in Post Office Square. Employees were asked their current mode of travel and their

[7] *General Services Administration. New Federal Courthouse Final Environmental Impact Statement. September 1992.*

intended mode at the new site. The 81 percent employee transit share was based on the intended mode question. Visitors were asked only their current mode. Visitors' and jurors' modes at the new site were estimated from this information.

An 81 percent estimated transit share for work trips is very high given the location and transit access that will be available in 1998. This level of transit usage is likely only at a downtown building with several rail transit lines nearby (such as the existing Federal Courthouse). The year 2010 projected transit share to the Fan Pier (for all trip purposes) is only 70 percent with the Full Build Transitway. A more comparable situation to the new Courthouse might be the World Trade Center. It is further from the rail transit lines than the new Courthouse would be, but it has frequent direct shuttle service for employees connecting to the Red, Orange, and Blue Lines and to both commuter rail terminals. Employees of the prime tenant at the World Trade Center also receive a benefits package that includes comparable transit and parking subsidies.

The current employee daily transit share for the prime tenant at the World Trade Center is 45 percent. Applying this percent to projected Courthouse daily employee trips and allowing a slightly higher peak hour employee transit share, plus reduced juror and visitor shares, yields the reduced transit demand trip estimate shown in Table 2-31.

TABLE 2-31: REDUCED COURTHOUSE DEMAND ESTIMATE

	Daily			A.M. Peak Hour		
Category	Trips	Transit	Transit Share	Trips	Transit	Transit Share
Employees	816	367	45%	555	278	50%
Jurors	200	50	25%	200	50	25%
Visitors	2,211	221	10%	304	46	15%
Total	3,227	638	20%	1,059	60374	35%

Interim year bus service was analyzed using both the Courthouse EIS and Reduced Demand scenarios.

2.7.3.3 Additional World Trade Center Transit Demand

While several new buildings are proposed for the World Trade Center complex, only the hotel, planned for Northern Avenue east of Viaduct Street, is expected to be in place by 1998. The proposed east and west office buildings along Northern Avenue will be constructed only as market conditions warrant but could be in place as soon as mid-1997 and mid-1998, respectively. Due to a current lack of specificity about its timing, the office component of the expansion project has not been assumed for the Interim Bus Service Plan.

The proposed hotel at the World Trade Center would increase transit ridership in the Piers area to a much lesser extent than would the new Courthouse. Data provided to the MBTA by the World

Trade Center based on the World Trade Center Expansion Environmental Impact Statement[8] show a projected 3,485 daily trips with 589 (17 percent) on transit. In the a.m. peak hour, there would be a projected 337 trips with 74 (22 percent) on transit. These estimates appear reasonable for the type of development and location. Many of the projected transit riders are expected to make use of the privately operated South Station to World Trade Center Shuttle.

2.7.4 Interim Year Route Options

Several options for modified and expanded bus service were examined for the interim year 1998. They include:

1. *Minor Route Modifications - The three existing MBTA routes modified to serve the Courthouse.*

2. *Split Route 6 - The service changes in Option 1 combined with changes to Route 6 (separating the Haymarket and South Station variations) in order to make more efficient use of capacity.*

3. *Combined Routes 3 and 6 (South Station) - Similar to Option 2 but with Route 3 and the South Station branch of Route 6 combined into a single route.*

4. *Dual Shuttle Services - Two shuttle routes serving the Courthouse — one from South Station and one from North Station, Haymarket, and State Street; existing routes modified to serve Summer Street and BMIP.*

5. *North Station Shuttle Service - Existing Route 7 modified and expanded to serve South Station to Courthouse demand with a new shuttle service from North Station, Haymarket, and State Street.*

6. *South Station Shuttle Service - A new shuttle route from South Station to the Courthouse with changes to Route 6 to provide service from Haymarket; existing routes modified to serve Summer Street and BMIP.*

A seventh option examined the combination of Courthouse shuttle services with a proposed North Station to South Station shuttle bus being considered as part of the MBTA's Central Artery mitigation program.

Other options were also considered, including a single shuttle service from South Station. These were found to be unworkable or were unable to provide a level of service that could be reasonably expected to attract the transit mode shares projected for even the reduced transit demand estimate.

2.7.5 Interim Year Service Plan

The selected option for interim year 1998 bus service is the North Station Shuttle Service option (Option 5 above). The North Station shuttle in Options 4 and 5 would provide a much better level of service for Orange Line, Blue Line, North Station commuter rail, and Haymarket express bus riders than could the modifications to Route 6 in options 1, 2, 3, and 6. This level of service would be essential in obtaining the high transit shares projected for the Courthouse and in obtaining the high transit share set as a goal for the Piers area. Option 5 is superior to Option 4 because the

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[8] *The World Trade Center's EIS included three office buildings in addition to the hotel. The office buildings are not expected to be completed before the opening of the Transitway. The World Trade Center's consultant extracted data for the hotel only for use by the MBTA in planning interim bus service.*

changes to existing service in Option 5 would provide a higher level of service from South Station than the dedicated service in Option 4, and at comparable cost.

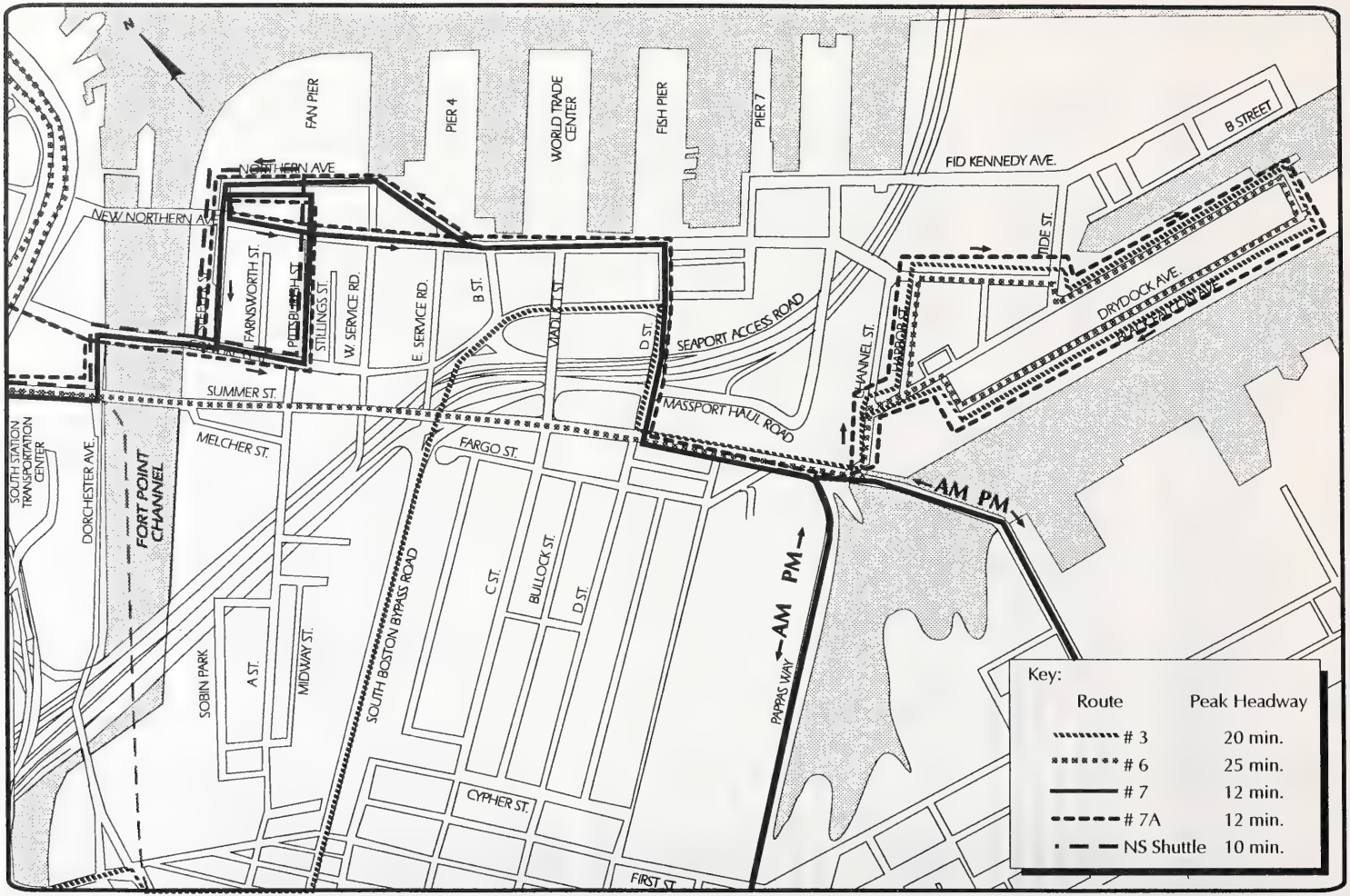
The interim bus service plan is summarized in Table 2-32 and is shown in Figures 2-19 and 2-20. The plan, which is subject to the availability of additional operating funds, includes the following services:

Route 3 - This route would be modified only slightly due to street changes. From Dorchester Avenue south of Broadway Station, it would use the new South Boston Bypass Road to Congress Street, then D Street and Summer Street to the BMIP entrance. It would then follow a one-way loop on Harbor, Northern, Dry Dock, Black Falcon, and Dry Dock again to the BMIP exit. The current 20 minute peak headway would be retained, and there would continue to be no off-peak service.

Route 6 - Route 6 would consist of only the current Route 6 Haymarket service. No changes would be made between Haymarket and South Station except those necessitated by mainline Central Artery construction. From South Station, the route would follow Summer Street directly to the BMIP entrance. It would then follow a one-way loop on Harbor, Northern, Dry Dock, Black Falcon, and Dry Dock again to the BMIP exit (the same as Route 3). The headway would be improved to every 25 minutes as a result of the travel time savings from the direct routing along Summer Street. There would continue to be no off-peak service.

Route 7 - This route would be modified to serve the Courthouse at all times. The present routing would be retained between City Point and Summer and D Street (including the Boston Harbor Industrial Park trips). From there, it would follow D Street, New Northern Avenue, Northern Avenue (past the Courthouse), Sleeper Street, and Congress Street to the present route to Federal Street. Outbound, it would follow the present route to Congress Street, then Pittsburgh, left onto Northern Avenue (past the Courthouse), Sleeper Street, New Northern Avenue, and D Street to the present routing on Summer Street. Current headways would be retained (12 minutes peak, 25 minutes off-peak).

Route 7A - This variation of Route 7 would replace the current South Station short variation of Route 6, although with greater frequency. In peak periods, it would be identical to Route 7 between downtown and the BMIP entrance on Summer Street. From there it would follow a one-way loop on Harbor, Northern, Dry Dock, Black Falcon, and Dry Dock again to the BMIP exit before returning downtown. With the full transit demand scenario, peak headways would be 12 minutes, the same as the regular Route 7. This would allow a combined 6 minute headway to be provided between downtown and the BMIP gate. (With the reduced transit demand scenario, only a 20-minute headway would be needed, making coordination with the full Route 7 more difficult.) In off-peak periods, a shorter variation would be operated between downtown and the Courthouse. The same route would be followed outbound to the Courthouse where it would then return via Sleeper and Congress Streets to downtown. The off-peak headway would be 25 minutes, the same as the full Route 7. This would allow a combined 12.5-minute headway to be provided between downtown and the Courthouse. This will be sufficient to serve off-peak Courthouse demand which consists mostly of visitors, many of whom would probably be coming from downtown offices.



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

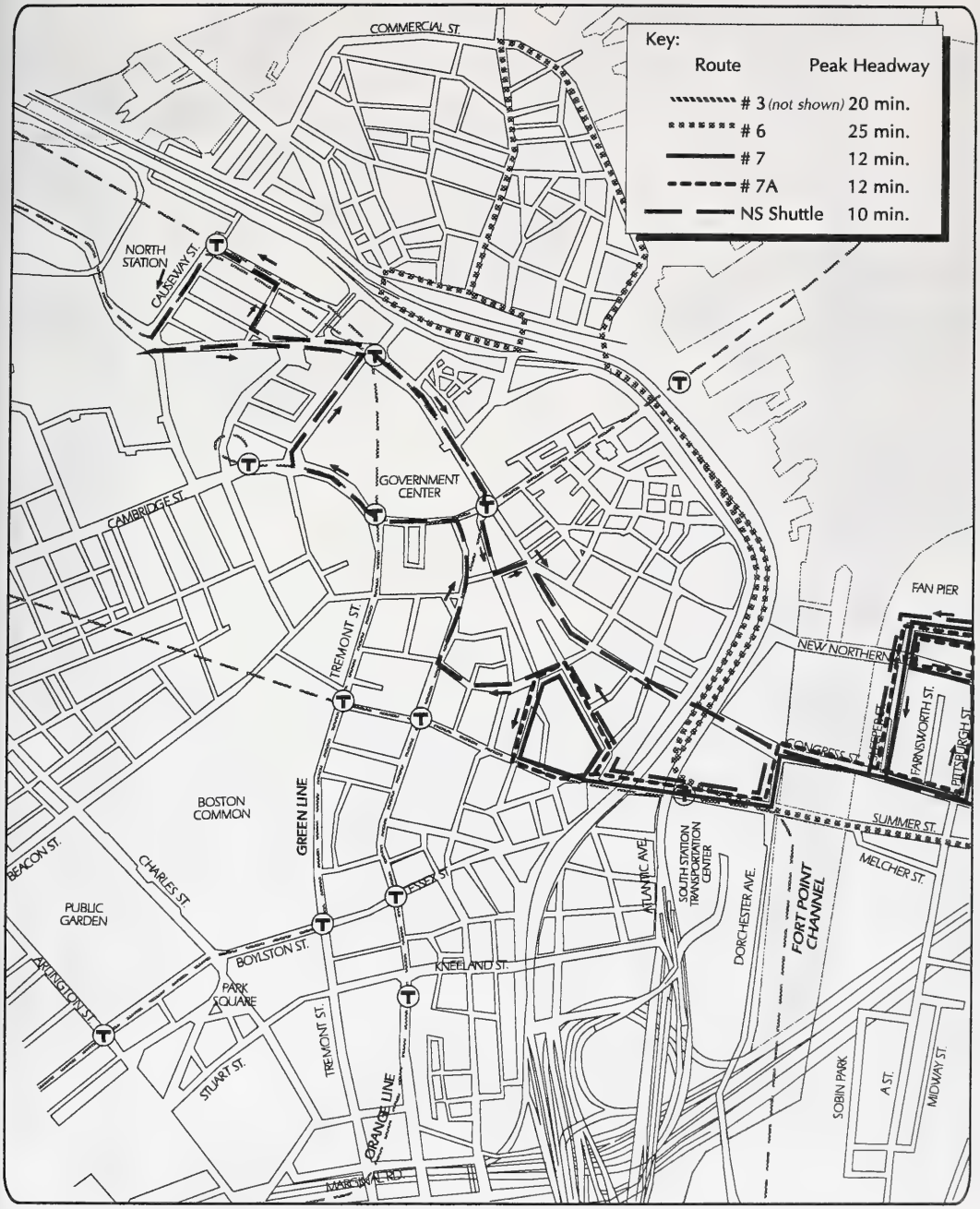
South Boston Piers/ Fort Point Channel Transit Project

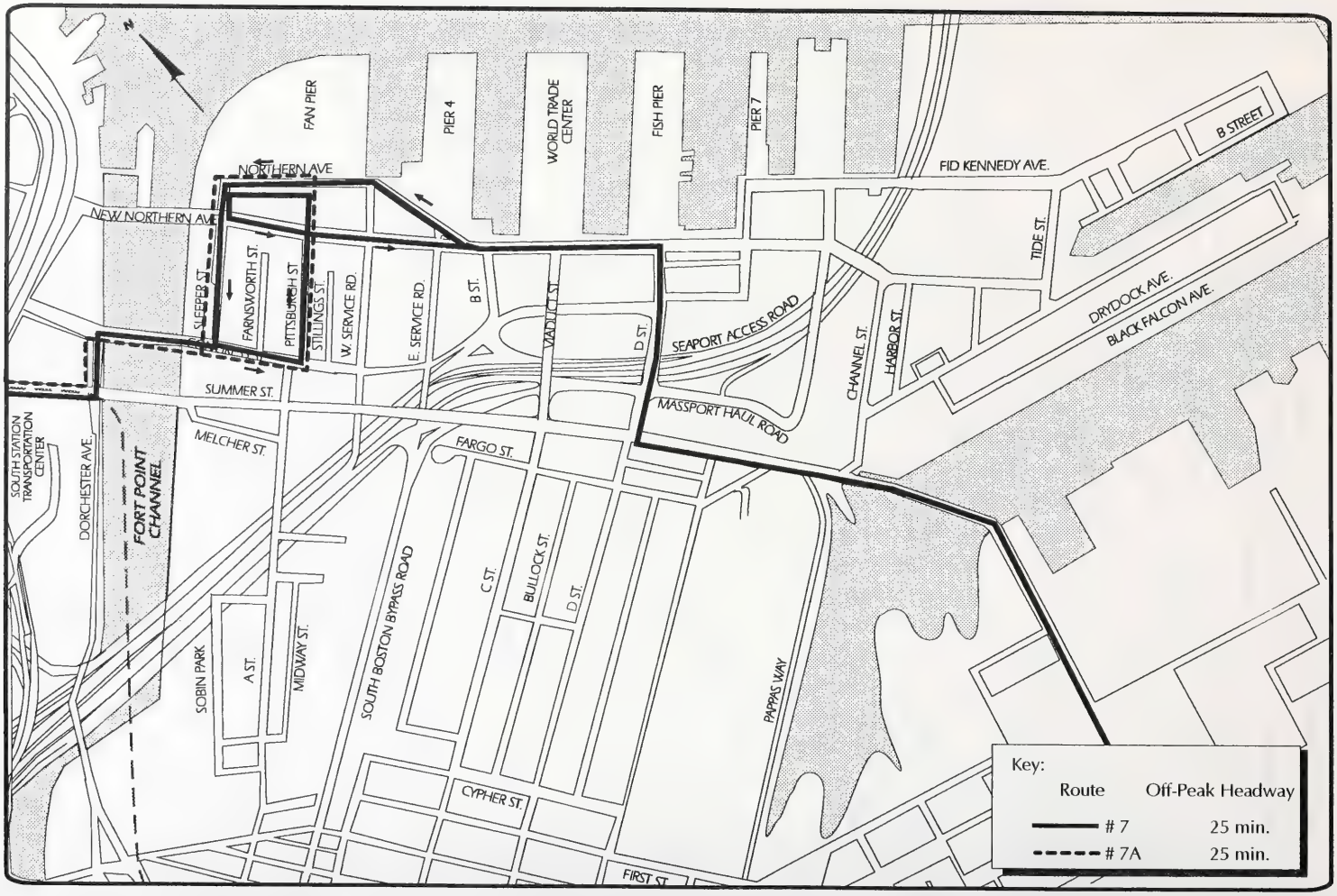
Fig. 2-19, 1 of 2
Interim Bus Service Plan - Peak Service

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fg. 2-19, 2 of 2
Interim Bus Service Plan - Peak Service





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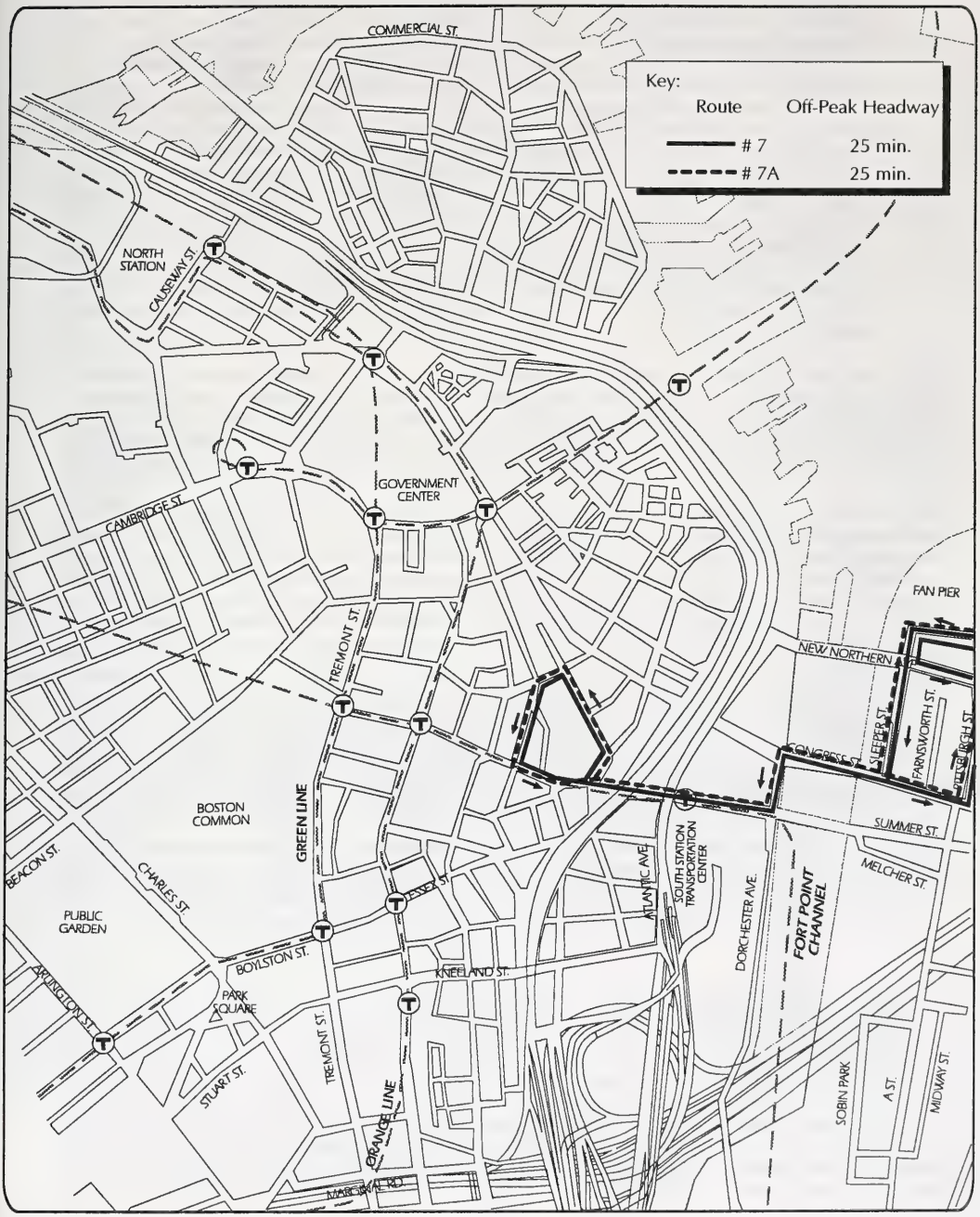
South Boston Piers/ Fort Point Channel Transit Project

Fig. 2-20, 1 of 2
Interim Bus Service Plan - Off-Peak Service

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fg. 2-20, 2 of 2
Interim Bus Service
Plan - Off Peak Service



North Station Shuttle - This new route would connect several downtown transfer points to the new Courthouse. Starting at a North Station layover point on or near Canal Street at the Green Line and Orange Line entrance, the route would follow Causeway Street and Merrimac Street to Congress Street at Haymarket Square where the existing Congress Street southbound bus stop would be used. The route would follow Congress Street to the intersection with State Street where a diversion will probably be needed onto Devonshire Street to serve a new stop accessible to the State Street Blue and Orange Line station. (A stop on Congress Street does not appear feasible at this location due to traffic considerations.) The route would follow Devonshire and Water Streets back to Congress Street and would continue across the Fort Point Channel with no further stops. It would follow Pittsburgh Street to Northern Avenue and have a layover stop in front of the Courthouse. The northbound route would follow Sleeper, Congress, Dorchester, Summer, High, Federal, Franklin, and Washington to a new bus stop at the State Street Blue and Orange Line Station at the corner of Washington and State Streets. It would then follow Court, Cambridge, Sudbury and Congress Streets to a new stop on Congress Street at Haymarket Square[9]. It would then follow Merrimac, Traverse, and Canal Streets to North Station.

Table 2-32 shows that seven additional peak period buses would be required with the Courthouse EIS Demand Scenario. Five additional peak period buses would be required with the Reduced Demand Scenario. One additional off-peak period bus would be required for either scenario. The service would increase MBTA annual operating costs by $1.0 million (in 1992 dollars). Operation of the services described here is contingent on the availability of these additional operating funds.

The service levels specified for the selected plan are consistent with the development projections discussed above. Additional development prior to the opening of the Transitway, such as the proposed World Trade Center Offices, could require additional interim service. The expansion of the World Trade Center would require either the eastward extension of the North Station Shuttle route or additional privately operated shuttle service from the Orange Line, Blue Line and North Station. It would also most likely require some combination of the expansion of the existing privately operated shuttle service from South Station and increased service on the Route 7/7A combination.

The plan is also subject to change based on MBTA decisions regarding additional downtown bus service being considered as part of the MBTA's Central Artery Construction Mitigation Program. The MBTA is currently considering providing a shuttle bus service in the downtown area connecting North and South Stations using the Congress Street corridor envisioned here for the North Station to Courthouse shuttle service. If such a North Station/South Station shuttle route were implemented, it could be modified to serve the Courthouse as well. Additional vehicles would be required to extend the route as well as to provide the additional capacity to serve North Station, Haymarket, and State Street to Courthouse trips. (South Station to Courthouse trips would be able to make use of capacity vacated by North Station to Financial District riders.) All Courthouse trips

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[9] *Two alternative northbound routings are possible. One would follow High Street (which will be northbound in 1998) to Pearl and Congress Streets. The location of a State Street stop would be a problem with this option. The second routing would use the New Northern Avenue bridge to Atlantic Avenue, a diversion past a stop at the Aquarium Blue Line Station, State Street, then Congress Street to Haymarket. A State Street stop may also be difficult with this option. Orange Line riders could use the Haymarket stop but this would substantially inconvenience Orange Line riders from the south. This option could also encounter delays due to Central Artery construction on Atlantic Avenue.*

TABLE 2-32: INTERIM BUS SERVICE PLAN SUMMARY

	Courthouse EIS Demand Scenario				Reduced Demand Scenario			
Route	Peak Hour Load	Peak Headway	Off-Peak Headway	Vehicles Required	Peak Hour Load	Peak Head-way	Off-Peak Headway	Vehicles Required
3	66	20 min.	–	2	66	20 min.	–	2
6	115	25 min.	–	2	133	25 min.	–	2
7	268	12 min.	25 min.	4.5	242	12 min.	25 min.	5
7A	281	12 min.	25 min.	3.5	171	20 min.	25 min.	2
North Station	291	10 min	–	5	180	15 min.	–	4
				17				15
Vehicles Used for Current Service				10				10
Additional Vehicles				7				5
Net Annual Operating Cost (thousands)				$833				$619

could be served by this single high-frequency route. Routes 6 and 7 would need to be modified so that they serve other parts of the Piers area.[10] The cost and number of additional buses required will depend on the frequency of shuttle bus service planned for non-Courthouse trips. A shuttle service with a 10-minute headway will require seven additional buses, including those needed for Route 6 and 7 changes; a 6-minute headway will require nine more buses; and the proposed 3-minute headway will require eleven more buses. This is comparable to the seven additional buses required for the selected plan but would result in higher frequency service for Courthouse riders and could therefore be capable of attracting a higher share of Courthouse trips to transit.

A decision on the North Station/South Station shuttle is awaiting state and federal funding approval. If it is implemented, extension of the route to the Courthouse would be included in the selected plan, along with the appropriate changes to Routes 6 and 7. Until such approval, the Single Shuttle Service option remains as the selected plan.

The selected plan represents a set of incremental changes from the present route structure yet moves the route structure toward the 2010 MOS-2 and Full Build Alternative route structures. Beyond 1998, Route 3 could be moved from the Bypass Road to the Seaport Access Road when

[10] *Route 7 would be the same as in the selected plan in order to provide access to the Courthouse from residential South Boston. Route 6 from Haymarket would be the same as in the selected plan, while the South Station variation would be retained and modified to match the Haymarket variation between South Station and BMIP. There would be no Route 7A.*

the new roadway is completed. As further development occurs, it could be expanded and split into the New England Medical Center and Copley Square shuttle routes to the Piers area and BMIP that are included in the MOS Alternatives. Upon completion of the Full Build Transitway, these routes would be discontinued. Route 6, upon opening of the Transitway initial phase (MOS-2), would no longer be needed to serve South Station to BMIP trips. It could then be changed to the 2010 alignment, which bypasses South Station.[11] Route 7A would be completely replaced by the initial Transitway service. The full Route 7 would be retained and could be moved to Congress Street from Northern Avenue as Congress Street develops from a construction detour to the boulevard envisioned by the Boston Redevelopment Authority. The North Station shuttle bus would be moved to the Surface Artery when it is completed, providing a faster, more direct service. By that time, Orange Line riders from the south using the shuttle from State Street would be able to use the greatly improved former Route 3 services which will travel more directly to the Piers area via the Seaport Access Road.

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[11] *Relocation of the terminal from Haymarket to North Station will depend on the MBTA's plans for bus terminal facilities in the Haymarket/North Station area.*

CHAPTER THREE
Affected Environment

CHAPTER 3. AFFECTED ENVIRONMENT

3.1 INTRODUCTION

Although the South Boston Piers/Fort Point Channel Transit Project has been undertaken to serve the Piers area, some service provided by project alternatives extends beyond the Piers area boundaries. As described in Chapter 2, each alternative provides services that connect to major transfer points in downtown Boston. In addition, the Bus/TSM and Transitway Alternatives also involve operation of express bus services to the Piers area from outlying suburban areas.

Much of the service provided by the project alternatives requires only modest increases in bus volumes in outlying locations. Such increases would therefore have negligible impacts in these locations. For this reason, the impact assessment conducted for this transit project is limited to the two major areas of Boston on which the new transit service is focused — the Piers area and downtown — where either increases in bus volumes are high or infrastructure would be constructed.

This chapter provides an overview and description of the current social, economic, and environmental resources and conditions in the South Boston Piers Transit Project area. It is intended to offer a general understanding of the area's resources that may be affected by the project alternatives as well as the major issues that must be considered when analyzing potential impacts. The chapter also discusses the methodologies utilized to identify significant resources. A detailed description of the methodology used for the evaluation of social, economic, and environmental impacts of project alternatives and a complete documentation of baseline conditions in the project area is provided in *Report No. 16: Social, Economic, and Environmental Impact Assessment* (MBTA, November 1992).

The four areas of concern covered in this chapter are: (1) neighborhoods, land use, and economic activity; (2) transportation; (3) the natural environment, including air quality, noise and vibration, ecosystems, water resources, and sediment disposal; and (4) cultural resources, including archaeological, historic, and parkland resources.

3.2 NEIGHBORHOODS, LAND USE, AND ECONOMIC ACTIVITY

This section identifies the neighborhoods, land use, and economic activity in the project area. As described above and shown previously in Figure 1-4, the project area is comprised of the South Boston Piers/Fort Point Channel area and downtown Boston. For purposes of this analysis, downtown is an amalgam of the South Station area, Chinatown/Leather District, and the Midtown District. Included in this section is a discussion of city zoning and other key development plans and policies that may affect the future character of development in each area.

Realization of the planned development and the high growth projections for the Piers area depends in part on the strength of the current demand for commercial space, the absorption of current available space, and renewed strength in the real estate market.

The boom in office construction in Central Boston in the early 1980s has slowed. New construction has diminished while commercial space available has increased. Table 3-1 shows the inventory of available space in existing commercial buildings, including those now under construction, for the Fort Point Channel (Piers) District as well as for the adjacent South Station and Financial Districts.

The current inventory ***(third quarter of 1993)*** of available space in existing buildings and in buildings under construction in the Financial, South Station, and the Fort Point Channel (Piers) Districts totals ***5.2 million*** square feet or ***16.1 percent*** of the total. Several years will be required for demand to absorb much of this available space before additional new space, related employment, and travel demand can be realized. Attainment of the high growth scenarios for the opening year and for the year 2010 depends on a return of a robust real estate market.

TABLE 3-1: AVAILABLE COMMERCIAL AND INDUSTRIAL SPACE IN SELECTED DISTRICTS OF CENTRAL BOSTON (in millions of square feet)

District	*Total Rentable**	*Total Available*	*Percent Available*
Financial	*27.2*	*4.3*	*15.9*
South Station/Fort Point Channel Area	*5.0*	*0.9*	*17.6*
Total	*32.2*	*5.2*	*16.1*

**In existing buildings and in buildings under construction.*

Source: Cushman and Wakefield, Market Research Department, third quarter 1993.

3.2.1 South Boston Piers/Fort Point Channel Area

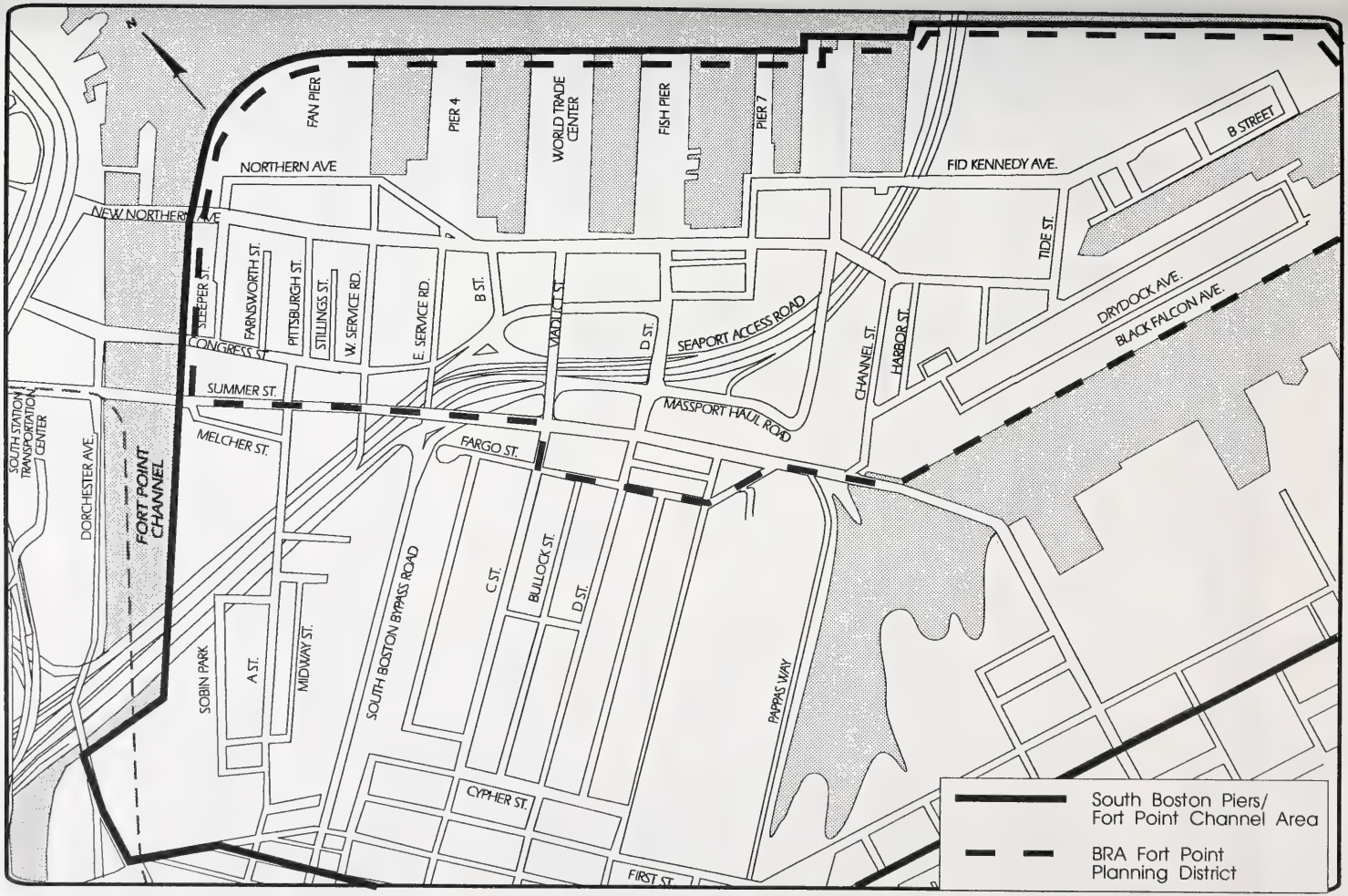
As shown in Figure 3-1, the project area includes that portion of the South Boston Piers/ Fort Point Channel area bounded on the north by Boston Harbor, on the east by the Reserved Channel, on the south by Summer and Fargo Streets, and on the west by the Fort Point Channel. The area constitutes the northern third of a larger planning district designated as the "Fort Point District" by the Boston Redevelopment Authority (BRA). This BRA district extends south from Summer Street to First Street. The streets shown in Figure 3-1 represent the planned roadway system for the project's design year of 2010.

3.2.1.1 Neighborhoods[1]

Demographics

There are approximately 400 to 500 residents currently living in the Fort Point District. The majority are artists living in studio/work space in the area of A Street. The age distribution of residents ranges from the mid-20s to mid-50s, with an average age in the late 30s. Most households consist of one or two persons. Because usual neighborhood conveniences are absent in the local area, there are very few family households. The median income of the Fort Point Channel artist community is $12,000. The majority of the residents are self-employed and work at home.

[1] Demographics from the 1980 census are presented for the entire Fort Point District; no breakdown is available for the northern third of the district which encompasses the Piers area portion of the project area.



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-1
South Boston Piers/Fort Point Channel Area and BRA Fort Point Planning District

While little demographic data has been developed, the residents of Sleeper Street, primarily of Dockside Place condominiums, are probably similar in many demographic characteristics to residents of the downtown. They are most likely professionals who enjoy the convenience of Sleeper Street to their downtown workplaces.

Housing

The neighborhood's housing units are clustered in the northeast corner of the district, along A Street and Sleeper Street. There are twenty-five buildings in this area which house artist living/work space. Within these buildings, there are approximately 200 housing units zoned for residential use and 200 studio spaces; many of these studios also serve as housing units, although they are not zoned for residential use. Most residents of the artist housing are tenants of the Boston Wharf Company. Less than one-fifth of the artist residents own their housing units.

The housing stock of the Fort Point District is particularly suitable for artist's lifestyles. Many artists work on a schedule that is more flexible than other occupations. They feel that their late working hours conflict less with the schedule of an industrial district than a residential area. Similarly, high ceilings, open interior spaces, and manufacturing utilities such as freight elevators fulfill some of the artists' practical needs. Artists work with materials and tools (such as ceramics and kilns, metal, and welding tools) similar to those used by light manufacturers. As a result, they feel comfortable living and working in a light manufacturing area such as the Fort Point District.

Neighborhood Cohesion

Although the residential community is small and occupies only a minor percentage of the land in the Fort Point District, it has a strong neighborhood identity. Residents, most of whom are self-employed artists, have a strong sense of affiliation. There is a high degree of participation in community activities.

The Fort Point Artists Community (FPAC) is a regional arts organization as well as the primary neighborhood association in the district. Although its membership includes artists who do not live in the neighborhood, FPAC's primary activities are to serve and advocate for residents. FPAC is a very strong and active neighborhood organization with widespread community participation. The group is concerned with maintaining affordable housing and quality living conditions for artists and other residents living in the area. The focus of their efforts is maintaining the thriving artist community against threats of displacement and disruption posed by future development.

3.2.1.2 Land Use and Economic Activity

The South Boston Piers area is a 300-acre peninsula adjacent to Boston's central business district (CBD). It is connected to downtown Boston by three antiquated local arterial bridges over the Fort Point Channel. As was so much of Boston, the area was created by landfill in the nineteenth century, and it quickly became a focal point of industrial, maritime, and railroad uses. The railroads terminated at Fan Pier, where they fanned out into a terminal yard. Nearby Sleeper Street — "sleeper" is the British word for railroad tie — attests to the railroad history of the area.

As Boston's role as an industrial, maritime, and railroad hub declined in the twentieth century, so too did the South Boston Piers area until it was largely abandoned in the years after World War II. When Boston's economy began to rapidly expand in the late 1970s, interest in the area was rekindled. Urban pioneers such as artists and small museums were attracted to the spacious warehouse space so close to downtown. The City of Boston acquired an abandoned Army base at the far eastern end of the area and promoted the location of light industrial and maritime uses. Commonwealth Pier, adjacent to Pier 4, was converted into the World Trade Center — a major conference and exhibition facility.

Today, four major industries, encompassing 178 individual firms, account for 90 percent of the 9,000 employees in the area. These industries are printing/publishing, apparel/textile, fish/food processing and

distribution, and trucking/transportation. The BRA's planning district accounts for some 35 percent of all industrial jobs in the city.

Land use in the BRA planning district is divided as follows:

Industrial	48 percent
Commercial	18 percent
Streets, water	17 percent
Vacant land	15 percent
Residential	2 percent
Public open space	Less than one-half percent

More than 53 percent of the land in this district is in public ownership.

Two-thirds of the vacant land in the South Boston Piers area is used for parking (12,761 spaces). Twenty-two percent of this parking is used by downtown commuters, most of whom park at Fan Pier which is located just across the Northern Avenue bridge and Fort Point Channel from the downtown waterfront and financial districts. Parking rates at Fan Pier have traditionally been lower than downtown rates.

Table 3-2 lists the major land uses by development parcel for the CA/T Project. This and subsequent tables include only those parcels in the project area. The zones are based on CTPS traffic forecasting districts that approximate City of Boston tax assessment districts, which in turn roughly correspond to identifiable development parcels. As shown, approximately 9.2 million square feet of development existed in the area in 1986, of which 7.3 million square feet (79 percent) was occupied. The most densely developed parcels are the World Trade Center, Museum Wharf area, Boston Marine Industrial Park, and the Summer Street office conversion.

As shown in Table 3-3, land use in the Piers area is dominated by industrial activities followed by office uses. Residential uses comprise only a small share of existing floor area.

Land use and ownership in the Piers area is divided roughly in thirds. In the western end of the area extending from the Fort Point Channel to B Street, land is owned primarily by private interests. This is the most densely developed portion of the area. Major private land holdings in this subarea are as follows.

Fan Pier - This 18.5-acre site is owned by the Fan Pier Land Company. Although the site is presently used primarily for downtown commuter parking, a 4.6-acre portion of the site has been sold to the General Services Administration for construction of a new federal courthouse.

Pier 4 - This 16.4-acre site is occupied by the Pier 4 Restaurant and a large parking lot for restaurant patrons. Anthony Athanas owns approximately 10.5 acres of this site with the balance owned by the Fan Pier Land Company.

McCourt Property - This largely vacant land is owned by the McCourt Company. The 23-acre property is "L" shaped, with one major parcel lying roughly between the proposed South Boston Interchange ramps of the Seaport Access Road and the proposed New Northern Avenue.

Museum Wharf - This site houses the Children's Museum, the Computer Museum, and the Boston Tea Party Ship Museum, as well as residential and office space in converted wharf/warehouse structures. Approximately one million visitors are attracted to the three museums annually.

Summer Street Office and Industrial Park - This site incorporates a combination of light industrial and office properties with further conversion to office facilities anticipated. This site is managed by the Pappas Management Company.

TABLE 3-2: SOUTH BOSTON PIERS/FORT POINT CHANNEL AREA 1986 LAND USE BY PARCEL* (thousands of square feet)

Zone	Development	Total	Occupied
233A	Fan Pier	8.1	6.7
233B	Pier 4	37.0	37.0
233C	McCourt	11.0	8.5
233D	World Trade Center	875.6	700.5
233E	Fish Pier	251.6	203.2
233F	Boston Wharf Co./Museum Wharf Area	1,513.8	1,216.5
233G	Boston Wharf Co.	1,026.2	785.9
233H	McCourt	0	0
233I	N.E. Seafood Center	78.7	65.1
233J	World Trade Center Expansion	139.5	111.1
237A	World Trade Center Expansion	25.1	20.0
237B	Massport	358.6	286.5
237C	General Ship	36.6	36.6
237D	Massport	291.9	232.2
237E	EDIC (BMIP)	3,114.0	2,480.2
70A	Summer St. Office and Industrial Park	1,386.0	1,082.1
TOTAL		9,153.7	7,272.1
OCCUPANCY RATE		79%	

* Excludes transportation related land uses.

Source: Massachusetts Department of Public Works. *Land Use Projections for the Boston Metropolitan Core, 1986 - 2010.* July 1989.

TABLE 3-3: SOUTH BOSTON PIERS/FORT POINT CHANNEL AREA 1986 FLOOR AREA BY CATEGORY* (thousands of square feet)

Land Use	Actual	Percent of Total	Occupied	Percent of Total
Office	2,342.8	25.6	1,774.2	24.4
Retail	290.4	3.2	244.0	3.4
Cultural/ Recreational	554.9	6.1	456.5	6.3
Industrial	5,862.6	64.0	4,697.5	64.6
Residential	102.9	1.1	99.8	1.4
Total:	9,153.7		7,272.1	

* Excludes transportation related land uses.

Source: Massachusetts Department of Public Works. *Land Use Projections for the Boston Metropolitan Core, 1986 - 2010.* July 1989.

New England Seafood Center - The New England Seafood Center is a 4.4-acre site located at 145 Northern Avenue, between the proposed Seaport Access Road off-ramp and B Street. The land and building are owned by the fifteen wholesale seafood companies that occupy the building under a general partnership agreement called the New England Seafood Center Cooperative Association. Approximately 300 people are employed on the site.

The central third of the area is owned by Massport. Massport is a quasi-public, self-financing agency charged with the operation of Logan Airport and a variety of maritime activities in and around Boston Harbor. Although Massport is not bound by local zoning regulations, it has historically attempted to work cooperatively with state and city agencies.

Massport owns the land bounded by B Street on the west, the Massport Haul Road on the east, and Summer Street on the south; it also owns Commonwealth Pier and the Fish Pier. Commonwealth Pier has been privately developed in recent years into the World Trade Center, a trade and exhibition facility composed of 850,000 square feet of cultural, office, and retail space. The Fish Pier continues to be devoted to fish industry-related activities, consuming a total of 259,000 square feet of primarily industrial space. The balance of Massport land is taken up by parking, limited light industrial and office uses, and vacant land. This area is referred to as Commonwealth Flats.

The eastern third of the area is owned primarily by the City of Boston Economic Development and Industrial Corporation (EDIC). EDIC's charter is to promote light industrial and maritime-related activities. It is the owner of the Boston Marine Industrial Park (BMIP), a 3.3 million square foot industrial park housing approximately 150 companies and 3,500 employees. Figure 3-2 displays the current layout of BMIP. The

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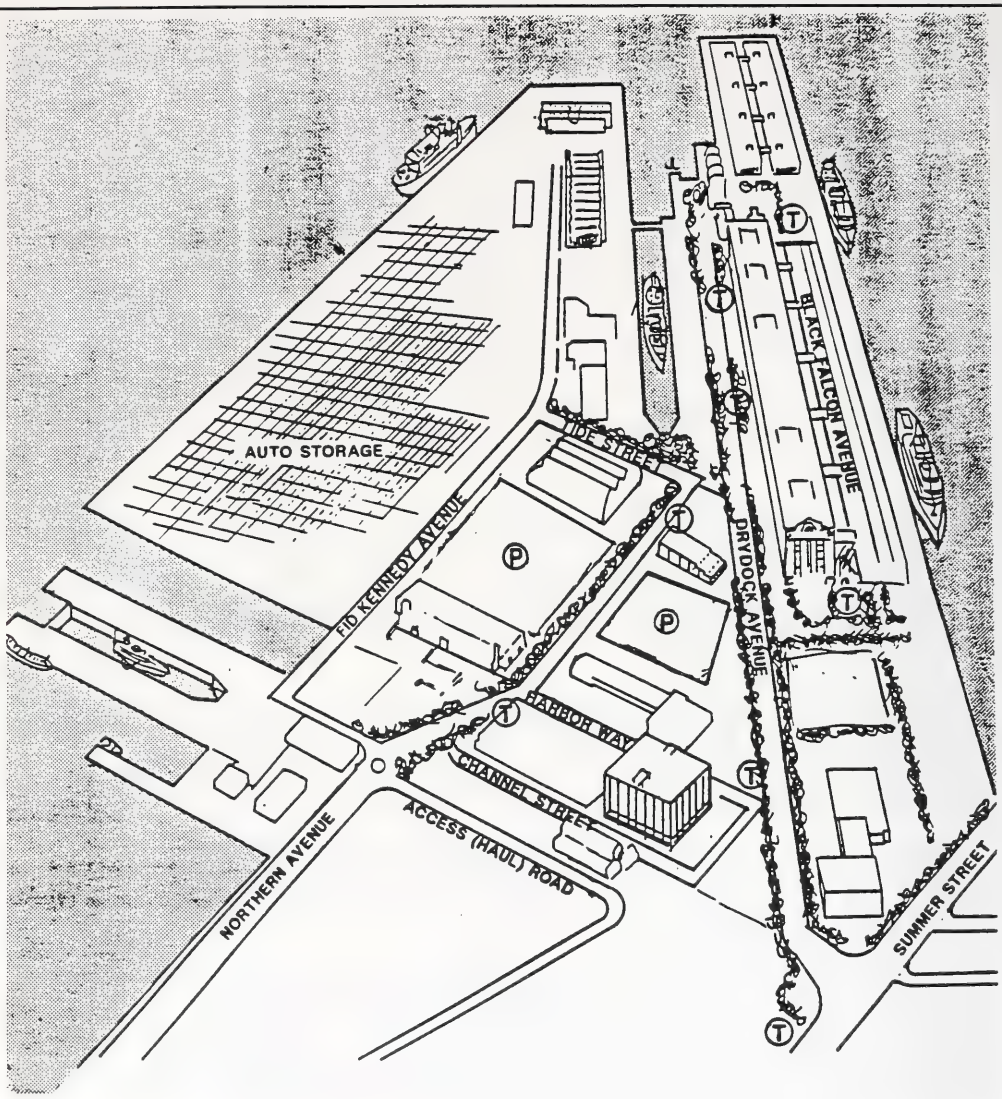
South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-2
BMIP Layout



BOSTON MARINE INDUSTRIAL PARK

KEY: (T) Station Locations (P) Public Parking

present focus of activity is Building F, the Boston Design Center. Other major tenants include General Ship Company, which operates a ship repair facility on Drydock No. 4, and Subaru Distribution Corp., which operates an automobile processing facility on the lot bordered by the Boston Harbor and Fid Kennedy Avenue.

3.2.1.3 Proposed Development Goals

Several factors are generating the potential for major changes in the South Boston Piers area. First, more than half of the land between the Fort Point Channel and the Fish Pier is vacant or underutilized. Combined with the following statistics compiled about the area in 1987, this high percentage of vacant land marks an area poised for change:

- 72 percent of building space is leased
- 85 percent of the leases will expire by 1993
- 74 percent of rents are less than $5 per square foot

Second, development of a comprehensive transportation system centered around the Seaport Access Road and Third Harbor Tunnel will transform this formerly isolated area into the gateway to Boston. Existing limited access will be remedied with direct connections to Logan Airport, I-93, and the Massachusetts Turnpike. Discontinuous narrow streets will be replaced by a new local street system and a Bypass and Haul Road for truck traffic. Improved transit service is needed to link the area to the entire MBTA system.

Finally, given its proximity to the CBD, the area is a logical place for future growth. During the 1980s economic boom, saturation of the downtown office market led developers to look for new sites beyond the traditional confines of the CBD. In recent years, for example, a considerable amount of office development has extended across the Charles River to Kendall Square in Cambridge. Based on proximity to the CBD and proposed improvements to the transportation infrastructure, the South Boston Piers area has been targeted by regional planners for future growth.

The goals of a master planning process undertaken by the Fort Point Citizens Advisory Committee and the BRA are detailed in the *Fort Point District Plan* (December 1990). That process produced seven primary goals for the district:

1. A Diversified Economy. To create an appropriate match between the district's traditional manufacturing base and Boston's recently expanded service economy, new research and development and manufacturing industries will be complemented by a mix of office, retail, hotel, and exhibition space development. This growth will result in 10,000 construction jobs and 32,000 permanent jobs within the district.

2. New Transportation Network. One billion dollars will be invested in new major roadway, tunnel, and public transit projects. Parking will be frozen at 10 percent above the current level.

3. New Housing Opportunity. An additional 2,500 units of market and affordable housing will be created.

4. Public Access/Open Space. Forty-five acres of open space will be added throughout the district. This goal will be achieved through the provision of public access to the waterfront, extension of Harborwalk, creation of new tree-lined boulevards along New Congress Street and New Northern Avenue, and open space designation above the Seaport Access Road.

5. Strengthening the Working Waterfront. Reinvestment in and expansion of all facets of the waterfront's commercial activity will focus on ensuring the future of New England's seafood industry and increasing the capacities of other port-related industries.

6. Protecting the Industrial and Manufacturing Base. Existing industrial and manufacturing jobs in the Fort Point District will be protected through zoning and regulatory controls and economic incentives

for expansion. Job training programs will focus on upgrading the skills of workers for new industrial demands, and child care programs will be developed to expand employment opportunities for the South Boston community.

7. Managing Balanced Growth. The key objectives under this goal will be to integrate the working waterfront and the commercial development area with residential, recreational, and cultural land uses; ensure the compatibility of new structures with existing patterns; preserve neighborhood integrity and character; and protect the art industry. New Fort Point zoning will guide growth throughout the district and establish height limits for the first time in twenty-five years. The zoning also reserves land for the maritime and industrial economies.

As shown in Figure 3-3, land use and density controls are designed to manage growth in the Fort Point Waterfront District by channeling new higher-density commercial development into vacant or underutilized land in the New Congress Street and New Northern Avenue corridors. A series of transition zones provide appropriate buffers between the New Congress Street and New Northern Avenue corridors and more sensitive areas. Low-scaled development planned along the waterfront would provide a pedestrian scale for the extension of the Harborwalk, and ensure that the Northern Avenue waterfront remains the focus of water-related public activities. New infill construction along the edges of the Boston Wharf area would be sensitive to its existing historic fabric. Moderately-scaled research and development and industrial uses planned along Summer and D Streets would buffer the adjacent fishing industry and other industries.

Under new zoning, the typical density for as-of-right development in the western half of the district between the Fort Point Channel and Fish Pier ("Fort Point Waterfront") is floor-to-area ratio (FAR) 3; a height limit of 125 feet could be increased to 155 feet with appropriate city and community review. Commercial uses would be concentrated along New Northern Avenue and New Congress Street. Housing would be oriented toward the Fan Pier and Pier 4 waterfronts, and along a major open space corridor extending from the Summer Street Steps to the Pier 4 Waterplaza. Research and development/industrial uses would be located along Summer and D Streets in the eastern half of the district ("Seaport Area"). Existing industrial uses would be encouraged to expand.

A 115-acre portion of the Seaport Area waterfront has been designated by the city as a Maritime Economy Reserve (MER) zone. MER zoning is designed to provide rigorous protection for specific, heavy industrial water-dependent uses in Boston Harbor. MER zone uses are limited to the maritime industries.

The greatest density will be possible within Economic Development Areas (EDAs), which would generate substantial public benefits for the Fort Point District, South Boston, and the city. The EDA zone extends along New Northern Avenue and New Congress Street. It has been located to relieve development pressures on the waterfront, adjacent industrial areas, and the Boston Wharf area. Within EDAs, the maximum FAR is 4.25, and the maximum height 250 feet. Heights within EDAs will be modulated on a block-by-block basis.

Table 3-4 displays total baseline (1986) and projected land use for the Piers area by parcel for the 2010 high growth and lower growth scenarios. As shown, total developed floor space is expected to increase from just over 9 million square feet in 1986 to 14.1 million square feet in the lower growth scenario and to 21.5 million in the high growth scenario with occupancy rates ranging between 80 to 100 percent. Thus, total land use is expected to more than double in the high growth scenario for 2010.[2]

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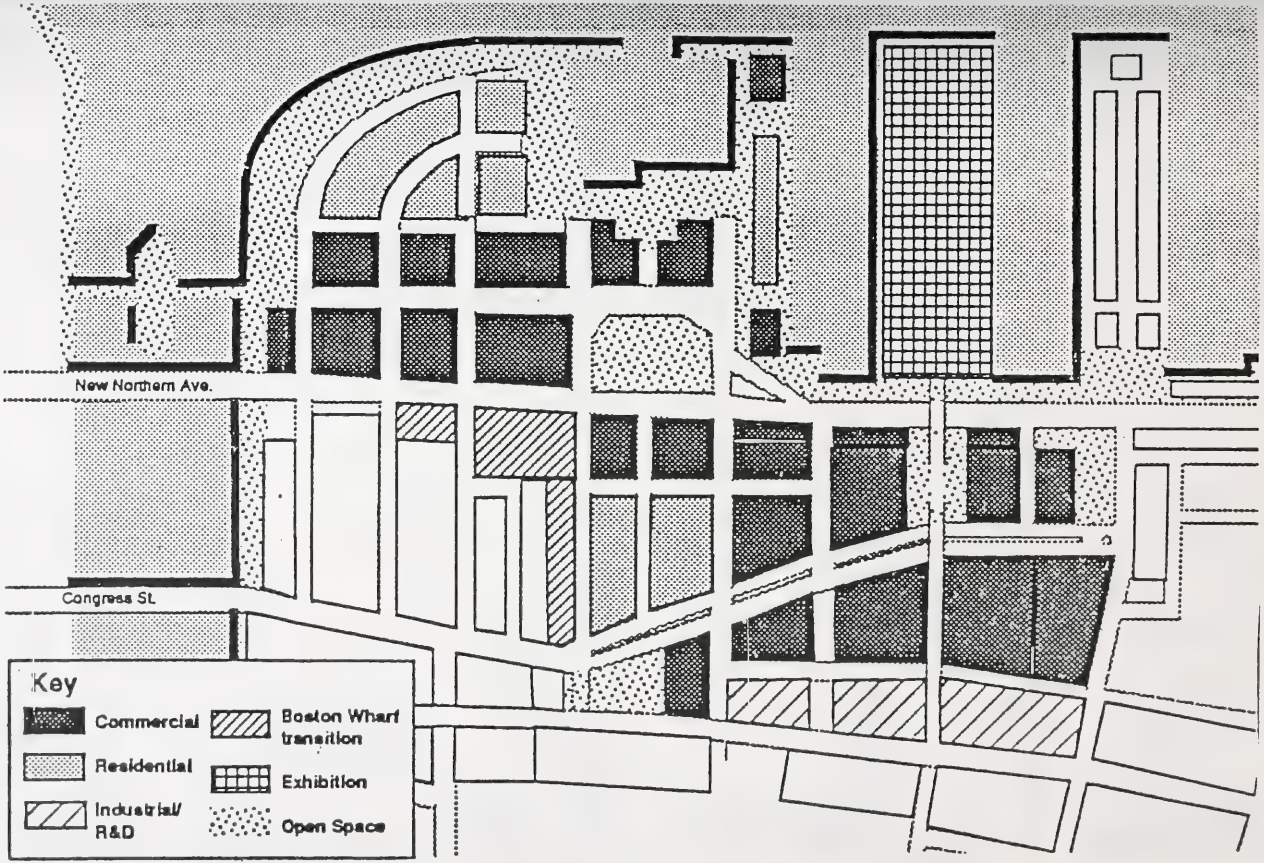
[2] ***Zonal designations and development projections presented throughout this document reflect projections prepared for the CA/T Project in July 1989. Piers area development projections shown are consistent with the land use projections for the expanded Boston metropolitan core prepared for the CA/T Project in December 1992.***



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-3
BRA Fort Point Channel District Plan

TABLE 3-4: SOUTH BOSTON PIERS/FORT POINT CHANNEL AREA
LAND USE BY PARCEL*
(thousands of square feet)

		1986		2010 Lower Growth		2010 High Growth	
Zone	Parcel	Total	Occupied	Total	Occupied	Total	Occupied
233A	Fan Pier	8.1	6.7	598.9	493.9	2,249.8	1,848.0
233B	Pier 4	37.0	37.0	349.8	294.4	1,148.2	965.9
233C	McCourt	11.0	8.5	278.5	222.8	1,081.0	846.8
233D	World Trade Center	875.6	700.5	875.6	743.9	875.6	743.9
233E	Fish Pier	251.6	203.2	340.4	274.2	506.6	407.2
233F	Boston Wharf Co./Museum Wharf Area	1,513.8	1,216.5	1,756.8	1,477.0	1,941.1	1,678.1
233G	Boston Wharf Co.	1,026.2	785.9	1,078.1	865.8	1,020.0	819.3
233H	McCourt	0.0	0.0	190.0	173.3	760.0	693.0
233I	N.E. Seafood Center	78.7	65.1	78.7	65.1	531.3	529.8
233J	World Trade Center Expansion	139.5	111.1	893.6	714.9	1,000.0	800.0
237A	World Trade Center Expansion	25.1	20.0	856.4	685.1	1,200.0	960.0
237B	Massport	358.6	286.5	558.5	447.7	1,173.5	940.5
237C	General Ship	36.6	36.6	39.3	39.3	39.6	39.6
237D	Massport	291.9	232.2	25.9	20.7	45.9	37.7
237E	EDIC (BMIP)	3,114.0	2,480.2	4,360.7	3,493.2	6,021.6	4,822.2
70A	Summer St. Office and Industrial Park	1,386.0	1,082.1	1,801.7	1,441.3	1,907.4	1,525.9
	TOTAL	9,153.7	7,272.1	14,082.9	11,452.6	21,501.6	17,657.9
	OCCUPANCY RATE	79%		81%		82%	

* Excludes transportation related land uses.

Source: Massachusetts Department of Public Works. *Land Use Projections for the Boston Metropolitan Core, 1986 - 2010.* July 1989.

Of perhaps as much significance as the total increase in developed land is the change in the mix among land use types. As shown in Table 3-5, industrial use is projected to decline from 64.0 percent of the total in 1986 to 42.9 percent in the lower growth scenario and down to 28.7 percent in the high growth scenario. Correspondingly, office space use is projected to increase from 25.6 percent of the total to either 42.7 percent or 48.0 percent in 2010. Since office space generates trips at almost four times the daily rate as industrial usage, and over four times the peak period rate, trip volumes would increase at a rate greater than the increase in total land use. Other land uses maintain relatively stable shares of total land development with the exception of residential use, which is expected to increase from 1.1 percent in 1987 to 9.6 percent of the total land area in 2010 in the high growth scenario.

Following is a parcel-by-parcel description of the major development plans for the South Boston Piers area. Development sites are shown in Figure 3-4.

Fan Pier - The unique qualities of Fan Pier, including its proximity to downtown and the waterfront, make this currently underutilized parcel a prime location for future development. A 4.6-acre portion of this site has been selected by the General Services Administration (GSA) for construction of a new 760,000 square foot Federal Courthouse. ***The courthouse is expected to support 816 employees and will be visited by over 2,200 persons each day. With only 63 parking spaces to serve the demand generated by these employees and visitors, the courthouse will rely on service provided by the South Boston Piers Transit Project. Land for the project was purchased by the GSA in November 1992, and construction is anticipated to begin in 1994. The Federal Courthouse will be opened in 1998.***

In the high growth scenario, the entire Fan Pier parcel is slated to encompass over 2 million square feet of development incorporating the Federal Courthouse in addition to a mix of office, hotel, and residential uses by 2010; ***it is likely that this mix will shift to more courthouse related uses***. In the lower growth scenario, a similar mix of 0.6 million square feet of development is projected.

Pier 4 - The Pier 4 parcel is about half the size of the Fan Pier parcel. Approximately 1 million square feet of development is projected for 2010 in the high growth scenario, with slightly less than half of the development devoted to residential uses; the remainder would be split between office, retail, and hotel uses. A similar mix is projected for the 0.4 million square feet of development in the lower growth scenario.

McCourt Property - No specific development plans have been made public with regard to this parcel. Development on the site will be somewhat constrained due to its shape, location, and the large number of public rights-of-way that are proposed to cross it. Nevertheless, it lies in the heart of the BRA's economic development area, and the developer plans high density development for the site. It is estimated that by 2010 in the high growth scenario, over 1.8 million square feet of primarily office development will occur. Only about 25 percent as much development is expected to occur on this site in the lower growth scenario.

Museum Wharf - The increase in total square footage in the Museum Wharf area will be relatively small (1.5 million square feet to 1.9 in the 2010 high growth scenario and to 1.8 in the lower growth scenario), but there will be a major conversion in type of use with industrial uses giving way to increased office and cultural uses. The Children's Museum, in partnership with the Computer Museum, announced plans in April 1992 to construct a $12 million waterfront project in front of the museums' existing shared building. The project will include a floating urban education center, a unique four-story wave-shaped building, and a public waterfront park featuring free festivals and exhibitions.

The World Trade Center - Plans for a major expansion of the World Trade Center onto Massport land located south of Northern Avenue consist of four mixed-use buildings that will reinforce the existing trade, exhibition, office, and conference facilities at Commonwealth Pier. The combined square footage of the four proposed buildings will be 1.75 million square feet. ***This includes 1,460,000 square feet of office space, 220,000 square feet of hotel space, and 70,000 square feet of retail space. The hotel is expected to be opened in 1997, with the remainder of the*** expansion project scheduled for completion by the year 2000.

TABLE 3-5: SOUTH BOSTON PIERS/FORT POINT CHANNEL AREA FLOOR AREA BY CATEGORY* (thousands of square feet)

		1986		2010 Lower Growth		2010 High Growth	
		Total	Occupied	Total	Occupied	Total	Occupied
TOTAL BY LAND USE	Office	2,342.8	1,774.2	6,015.0	4,829.0	10,322.5	8,375.1
	Retail	290.4	244.0	435.8	360.4	833.7	683.5
	Cultural/ Recreational	554.9	456.5	592.9	512.2	663.4	575.7
	Industrial	5,862.6	4,697.5	6,039.4	4,839.4	6,172.6	4,946.0
	Hotel	0.0	0.0	229.0	183.2	1,445.0	1,156.0
	Residential	102.9	99.8	770.7	728.3	2,064.3	1,939.7
	TOTAL	9,153.7	7,272.1	14,082.9	11,452.6	21,501.6	17,657.9
% OF TOTAL BY LAND USE	Office	25.6%	24.4%	42.7%	42.2%	48.0%	47.4%
	Retail	3.2%	3.4%	3.1%	3.1%	3.9%	3.9%
	Cultural/ Recreational	6.1%	6.3%	4.2%	4.5%	3.1%	3.3%
	Industrial	64.0%	64.6%	42.9%	42.3%	28.7%	28.0%
	Hotel	0.0%	0.0%	1.6%	1.6%	6.7%	6.5%
	Residential	1.1%	1.4%	5.5%	6.4%	9.6%	11.0%

* Excludes transportation related land uses.

Source: Massachusetts Department of Public Works. *Land Use Projections for the Boston Metropolitan Core, 1986 - 2010.* July 1989.

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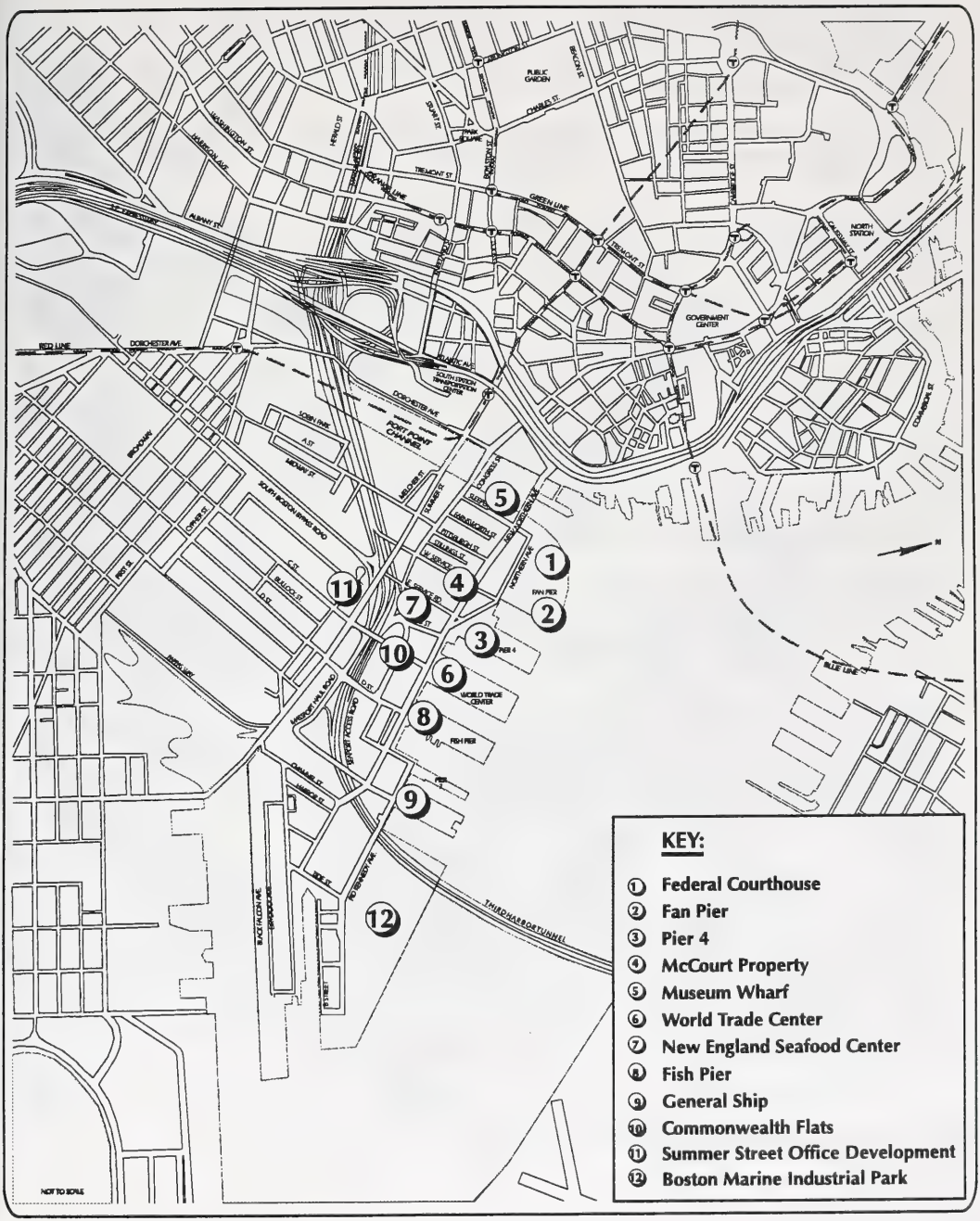
South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-4
Piers Area
Development Sites



New England Seafood Center - The partnership that owns the New England Seafood Center has no specific development plans, other than to maintain their business at an appropriate location. Projections prepared for the CA/T Project assumed that given the conversion of the surrounding properties to high density office development, extensive development (around half a million square feet) will also occur on this site. This estimate would appear to presume a relocation of the Seafood Center. In the lower growth scenario, the existing development on this site is assumed to be unchanged.

Fish Pier - Massport plans to maintain fish industry-related activities on this site, but also proposes to add approximately 255,000 square feet of office space at the entrance to the pier in the high growth scenario, or 166,000 square feet in the lower growth scenario.

General Ship - A revision in the alignment of the Seaport Access Road/Third Harbor Tunnel was designed to permit continued operation of General Ship on its existing site. Thus, roughly the same level of development as exists today is projected for 2010 under either scenario.

Commonwealth Flats (Massport) - This site will be used for the World Trade Center expansion discussed earlier, and other Massport development. While some of this land will be lost to the Seaport Access Road, Massport is planning major development in the northern half of this area. A proposed street grid system was laid out in the 1983 Cross Harbor and Regional Transportation Alternatives (CHART) report. The focus of this street pattern, as shown in Figure 3-5, will be the proposed "New Street" which would run parallel to Northern Avenue and be a center of activity in the area. New Street would run roughly along the alignment of the present Ramp Street; Ramp Street currently provides access up to Viaduct Street which in turn connects the World Trade Center to Summer Street at the second floor level. Year 2010 high growth projections call for a total of 1.2 million square feet of development, primarily light industrial and office uses (aside from the previously discussed World Trade Center expansion). Roughly 856,400 square feet of development is projected in the lower growth scenario.

Summer Street Office and Industrial Park - This site, which currently contains 851,000 square feet of industrial development and 533,000 feet of office space, is expected to undergo a major conversion to office space, with the balance shifting to 1,483,900 square feet of office space compared to 413,800 feet of industrial space. The difference between the high growth and lower growth scenarios is less than 5 percent.

Boston Marine Industrial Park - Already the largest single development in the Piers area with 3.3 million square feet today, BMIP has proposed to construct or renovate between ***700,000 and 1 million*** square feet of industrial, research and development, and other supporting commercial space by the year 2000. ***This development will result in the addition of 1,500 employees at BMIP.*** A total of 6.3 million square feet of development is projected by 2010 under the high growth scenario, while 4.4 million square feet are projected under the lower growth scenario.

3.2.2 South Station Area

For the purposes of this project, the South Station area includes a portion of the Financial District bordered by Northern Avenue to the north, the Fort Point Channel to the east, and the Central Artery to the west, in addition to South Station and Dewey Square. The area would be a major focus for operation of each transit alternative. In the Transitway Alternatives, a new lobby and platform would be constructed at South Station. The new Transitway Station elements would be incorporated into the existing station in a manner that would facilitate transfers from the Red Line and provide ready access to and from all Amtrak, commuter rail, and bus facilities at the South Station Transportation Center.

3.2.2.1 Demographics

No residential community occupies the South Station area.

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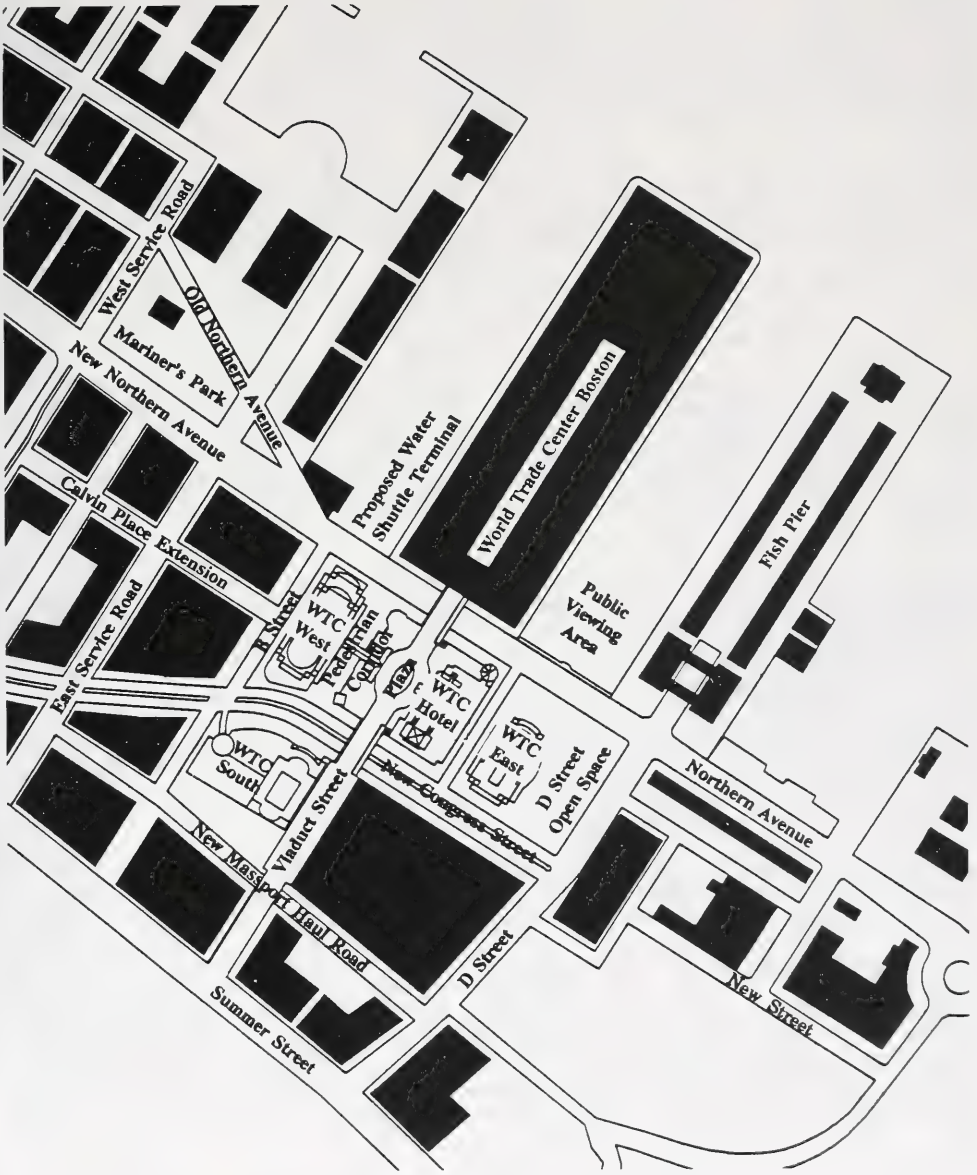
South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-5
Commonwealth Flats - Proposed Street Layout



3.2.2.2 Land Use and Economic Activity

The South Station area is dominated by public facilities and new mid- to high-rise office buildings, most of which house large firms associated with financial services. At the center of the area is the South Station Transportation Center. The recently renovated station includes a direct connection to the Red Line, enhanced commuter rail track and platform space, and a restored and remodelled historic headhouse. Other public facilities in the South Station area include the South Boston Postal Annex, the city's central mail distribution facility, which is located adjacent to South Station. Also located in the area are the Trailways/Peter Pan bus terminal and MBTA subway car storage at Cabot Yard. The Federal Reserve Bank is situated on the block bounded by Atlantic Avenue, Dorchester Avenue, and Summer and Congress Streets.

Heavy streams of multi-lane traffic and bus staging areas on what are some of the most congested streets in the city make a pedestrian-oriented environment in this impact area virtually impossible. As a consequence, retail activity is limited and community facilities are non-existent.

Major land uses located in the South Station area are shown in Figure 3-6 and listed in Table 3-6.

3.2.2.3 Proposed Development Goals

The character of the South Station area will be significantly altered by the Central Artery project. City proposals for the reuse of additional land created by the depression of the Central Artery include a mix of uses. In the immediate vicinity of the South Station area, the plan calls for the creation of an urban arboretum, a conservatory and botanical garden, and a formal garden and linear park organized around a lawn or reflecting pool. The new street network resulting from the Central Artery project is also likely to improve the area's current traffic and associated adverse environmental conditions, thereby enhancing pedestrian access and relieving safety problems.

Future development in the area includes the next phase of renovation at the South Station Transportation Center. Construction of a bus terminal above the station tracks and platforms with a ramp connection to the Central Artery/Third Harbor Tunnel began in 1992. Later phases of air rights development consist of construction of the South Station Technology Center, including research facilities, commercial office and retail space, and associated parking. Development will occur in three phases. Phase 1, beginning construction in 1995, will consist of 360,000 square feet and eight floors of biomedical research space in the southernmost portion of the site. Phase 2 will include a twenty-three story building with 650,000 square feet of office and laboratory space. This building, planned for the middle section of the site, will begin construction in 1997. Phase 3, beginning construction around the year 2000 in the northern section, will be a forty-story building with 1.1 million square feet of office space.

Future development elsewhere in the South Station area includes expansion of the existing Harbor Plaza adjacent to the Boston Edison substation site. Preliminary plans for this expansion consist of a new office tower and residential site.

3.2.3 Chinatown/Leather District

Chinatown is an area generally bounded by Essex Street to the north, the Massachusetts Turnpike to the south, the Surface Artery to the east, and Tremont and Washington Streets to the west. For purposes of this study, discussion of Chinatown will include the Leather District. The Leather District is a nine-block area located adjacent to the eastern boundary of Chinatown and bounded by Kneeland Street to the south, Essex Street to the north, Atlantic Avenue to the east, and the Surface Artery to the west.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-6
Land Use
South Station Area

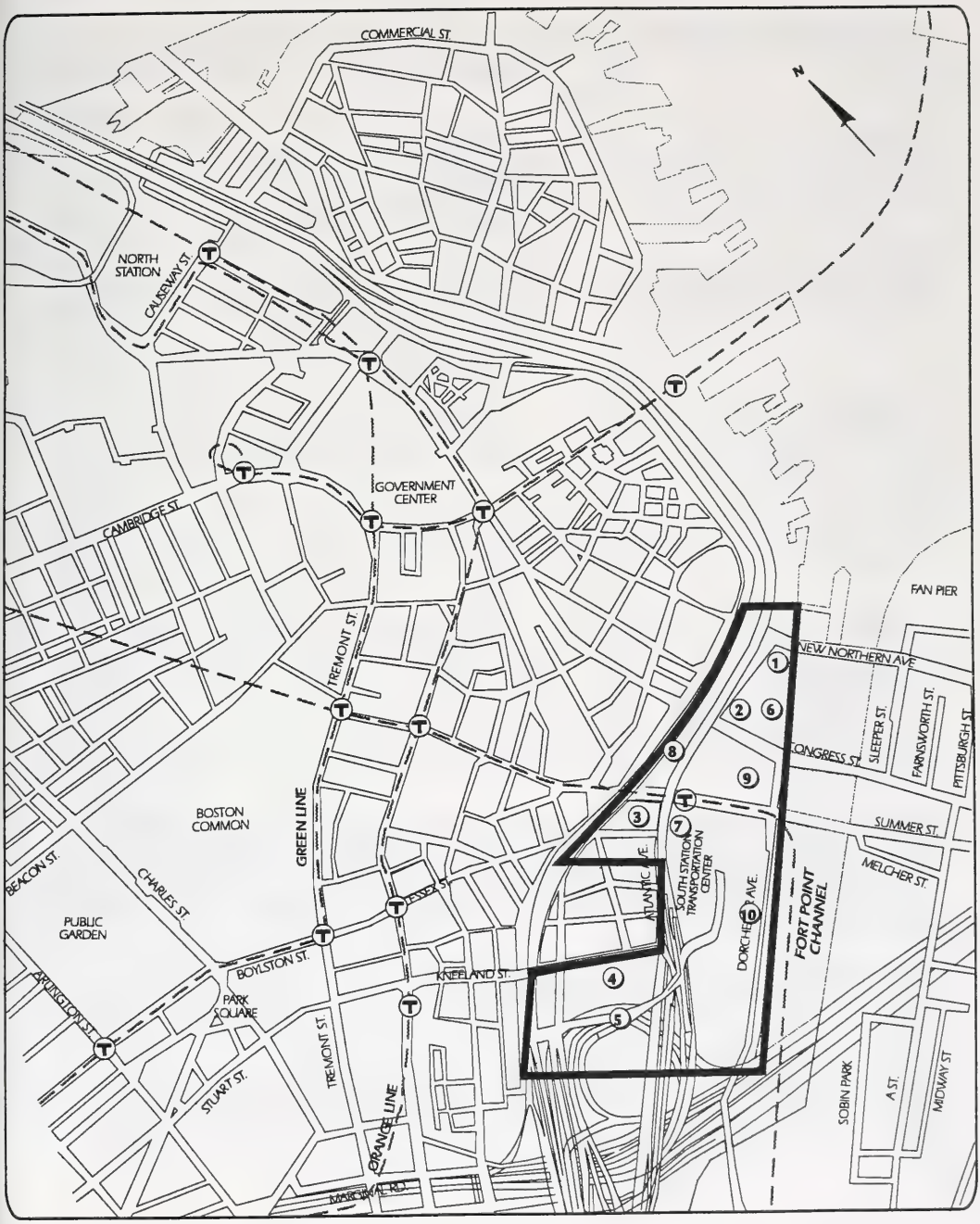


TABLE 3-6: MAJOR LAND USES IN THE SOUTH STATION AREA

Type	Map Number	Facility Description
Commercial	1	Harbor Plaza Building
	2	Russia Wharf
	3	One Financial Center
	4	Boston Thermal Corporation
	5	Massachusetts Highway Department
Industrial	6	Boston Edison Substation
Public Facilities	7	MBTA South Station Transportation Center
	8	Trailways/Peter Pan Bus Terminal
	9	Federal Reserve Bank of Boston
	10	South Boston Postal Annex

Source: Federal Highway Administration, *Land Use, Community Facilities, and Economic Activity Report*, June 1983.

City of Boston, Topographic and Planimetric Survey Maps, 1986.

A portion of the Underground Transitway Alternatives alignment would pass beneath Essex Street. Essex Street borders the northern fringe of Chinatown. The proposed bus routes associated with the Bus/TSM Alternative will travel along Herald Street and Marginal Road. These roadways comprise the southern boundary of Chinatown.

3.2.3.1 Neighborhoods

Demographics

Chinatown is one of the fastest growing neighborhoods in the city. Population has more than tripled since 1970, growing from 1,570 to 5,100 in 1987. Population growth has been constrained only by a serious housing shortage. The population increase is attributable to an influx of Chinese, Vietnamese, Taiwanese, and other Asian immigrants within the last two decades. Chinatown's role as a home to many newly arrived or first generation immigrants is evidenced by the fact that approximately 60 percent of its residents speak little or no English.

The neighborhood is largely homogenous in race and ethnicity. In 1980, 80 percent of the residents were Asian, 14.8 percent white, and 4.2 percent black. Within the Asian population, 91 percent were of Chinese ancestry.

The Chinatown population contains a larger than average proportion of elderly persons and children. Residents are family-oriented and many live together as extended families. Compared to citywide neighborhoods, Chinatown residents have less formal education and lower income levels. The relative lower income of Chinatown residents is partly explained by the prevalence of retail, restaurant, and other service occupations which typically offer lower pay and part-time work. Almost half (44 percent) of the

residents work in retail and wholesale trade while the remainder work in the service industry. In 1980, about one-quarter of Chinatown residents were employed in manufacturing.

There are less than 50 residents in the Leather District. They are primarily middle-aged professionals who work in downtown Boston. The Leather District is a small portion of a larger downtown census tract (701) and hence the census data are not reflective of this subarea.

Housing

There is currently a serious housing shortage in Chinatown. In 1985, there were approximately 1,478 housing units in Chinatown supporting roughly 5,000 residents. Only 70 units have been constructed since the mid-1970s although the population has almost tripled since then. Many of the housing units are small apartments and unsuitable in size for extended families. Thus, overcrowding is a serious problem.

Housing in the Leather District consists of converted light industrial and warehouse space. Units are primarily studio/loft type apartments and condominiums. Similar to Chinatown, residents live on second and third floors while commercial establishments and offices occupy the first floor.

Neighborhood Cohesion

Chinatown appears to be a very cohesive neighborhood. When outsiders come to Chinatown, they are very aware of the neighborhood's unique character. A common ethnic background, an extended family structure, and an active pedestrian environment make Chinatown a stable, cohesive neighborhood.

Residents of the Leather District, on the other hand, are relative newcomers to the area. A substantial number of condominium owners, tenants, and property owners are members of the Leather District Neighborhood Association which addresses issues of community concern. The relative isolation of the Leather District, similar professional orientations, and a shared urban pioneering experience may have created a sense of social cohesion among the subarea's residents.

3.2.3.2 Land Use and Economic Activity

Chinatown is a mixed-use neighborhood located in a light manufacturing district. The area supports a variety of land uses including commercial, retail, institutional, manufacturing, and residential. Both the manufacturing industries and service/retail industries are major employers of the Asian community. The service industry in Chinatown is dominated by health-related services with Tufts New England Medical Center as the major health-related service employer in Chinatown. Other service/retail jobs are primarily in local restaurants and shops.

Manufacturing firms in Chinatown are predominantly associated with apparel/textile production or science-related manufacturing, such as electronics. Recently, however, many manufacturing firms have relocated their operations to areas where the cost for industrial space is less per square foot (e.g., BMIP). Chinatown, like many neighborhoods that border the downtown area, has experienced the effects of an expanding CBD, namely rising property values, conversion of industrial space to office use, and the development of other non-residential uses.

The majority of businesses in Chinatown are located in four- to seven-story warehouses or medium-rise office buildings along Kneeland Street. Commercial firms such as restaurants, import-export companies, and Chinese cinemas are located north of Kneeland Street. Institutional and some retail uses, such as local grocery stores, are located south of Kneeland Street. While residential use is found scattered throughout the Chinatown area in low-rise brick row-houses, dwelling units are concentrated primarily in a few large apartment buildings including the Mass Pike Towers, Quincy Towers, Chauncy House, and Tai Tung Village.

Tufts New England Medical Center has been responsible for the majority of new institutional development in Chinatown since 1975. Projects completed by Tufts in 1982 and 1983 added over 400,000 square feet to their existing facilities.

The Chinese Economic Development Corporation represents the most recent major commercial development project in Chinatown. Known as the China Trade Center, the facility provides approximately 95,000 square feet of retail and office space.

Also located within the boundaries of Chinatown is a portion of the Combat Zone, an adult entertainment district. The Combat Zone businesses are generally situated along Washington Street, north of Kneeland Street.

The Leather District has historically supported leather and apparel manufacturing industries. It is only recently that the composition of the area has expanded to include office, commercial, and limited residential use.

Structures in the Leather District typically consist of large five- and six-story brick buildings constructed in the late nineteenth century. These manufacturing/warehouse structures are now being converted to mainly commercial and residential condominium space. The proximity of the Leather District to downtown Boston, public transportation, and the regional roadway system makes the area especially appealing as a burgeoning office market. Recent renovation projects have reflected the development of prime office space. The Teradyne Company, a leading manufacturer of automated testing equipment, is the largest employer in the Leather District, employing over 500 persons.

The major facilities in Chinatown are shown in Figure 3-7 and listed in Table 3-7.

3.2.3.3 Proposed Development Goals

The BRA's 1990 *Chinatown Community Plan* includes several measures aimed at revitalizing the Chinatown community. Newly amended zoning for Chinatown supports achievement of this goal. Policy goals and objectives of the *Chinatown Community Plan* are:

- To strengthen the family orientation of the neighborhood by containing the Combat Zone activities and by creating affordable housing.
- To expand Chinatown's economic base by reinforcing community services and providing opportunities for the growth and diversification of business and employment.
- To strengthen Chinatown's cultural heritage, historic legacies, and environment by enhancing its unique streetscape, upgrading its pedestrian-oriented environs, and reinforcing its community infrastructure.
- To protect Chinatown's land base by redirecting institutional growth to the periphery of the district and preventing further highway construction that infringes on the neighborhood.
- To support Chinatown's future growth by building "land bridges" at the Hinge Block, the Chinatown Gateway area, and the Turnpike Air-Rights area, which connect Chinatown with the Midtown District, the South Station Economic Development Area, and the South End.

The BRA's Interim Planning Overlay District (IPOD) zoning for the Leather District has established it as a Restricted Growth Area. A Restricted Growth Area limits new infill development and instead promotes the rehabilitation and reuse of existing structures to suit retail, office, and residential uses. Future plans may establish the district as a Housing Priority Area requiring that 25 percent of all development be used for housing.

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South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-7
Land Use
Chinatown

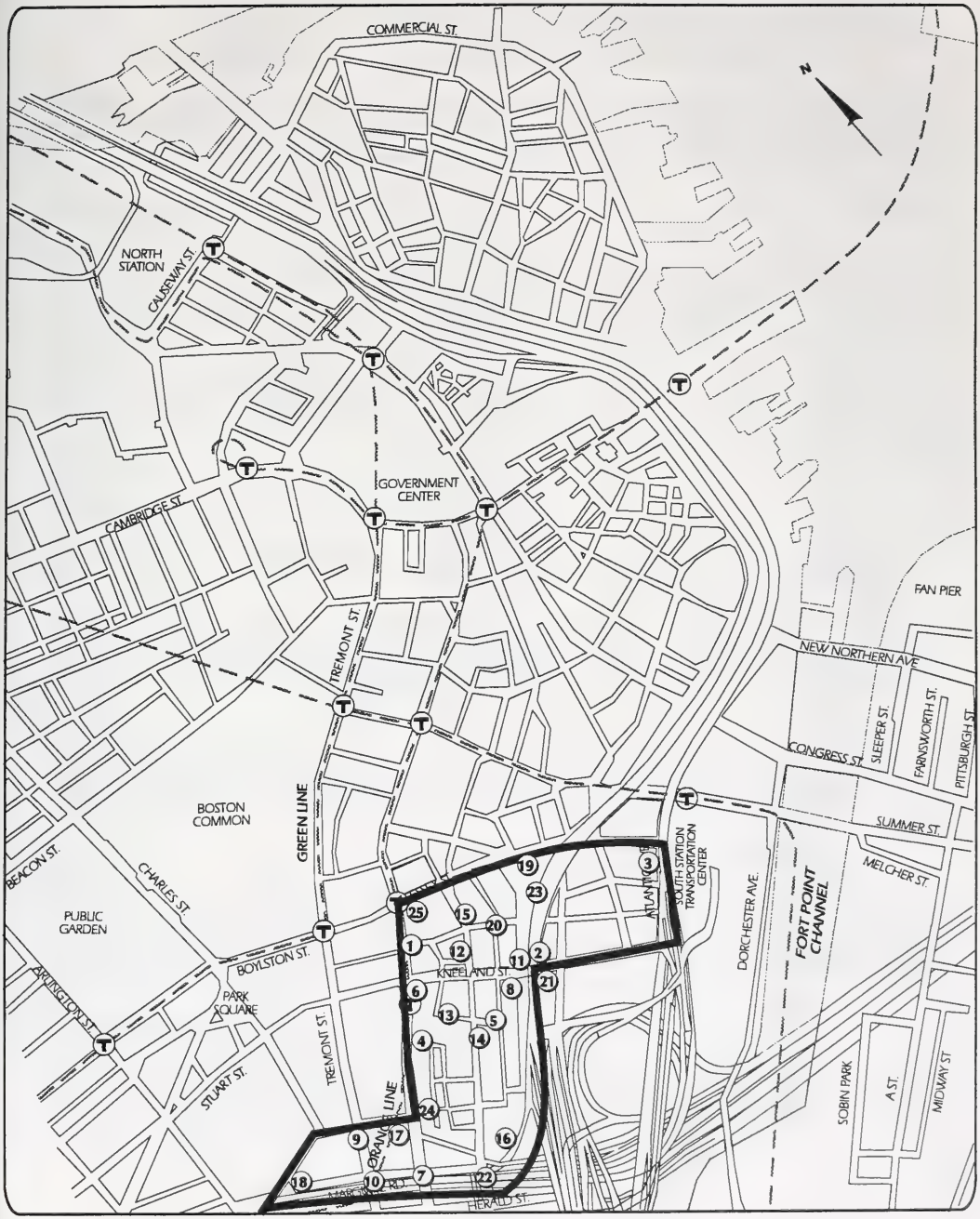

TABLE 3-7: MAJOR LAND USES IN CHINATOWN AND THE LEATHER DISTRICT

Type	Map Number	Facility Description
Commercial	1	China Trade Center
	2	Teradyne Company
	3	The Essex Hotel
Institutional	4	Tufts New England Medical Center
	5	Tufts Medical and Dental School
	6	USDA Building
	7	Quincy Community School
	8	South Cove YMCA
	9	South Cove Community Health Center
	10	Golden Age Center for the Elderly
	11	Chinese Merchants Association
	12	Chinese Economic Development Council
	13	St. James Roman Catholic Church
Residential	14	Tufts Medical School Dormitory
	15	Hong Lok House
	16	Tai Tung Village
	17	Quincy Tower Apartments
	18	Mass Pike Towers
	19	Oxford Place
	20	Chinagate Housing Development
Recreational/Cultural	21	Pagoda Park
	22	Tai Tung Park
	23	Chinese Gateway Park
Public Facilities	24	MBTA Orange Line, New England Medical Center/South Cove Station
	25	MBTA Orange Line Chinatown-Essex Station

Source: Federal Highway Administration, *Land Use, Community Facilities and Economic Activity Report*, June 1983.

City of Boston, Topographic and Planimetric Survey Maps, 1986.

There are several development projects in Chinatown in varying stages of planning. Brief descriptions of key projects are as follows:

- **Parcels A, B (Oak, Washington and Marginal Streets) and C (Oak, Nassau and Washington Streets):** ***The City of Boston, in cooperation with the Chinatown community, has proposed residential development for Parcels A and B. Plans for Parcel A include 100 or 150 units of housing at least 50 percent of which will be affordable. Construction on 88 units of house (68 units of affordable housing) on Parcel B will begin in late 1993. Among other uses, a community support facility is being considered for Parcel C.***

- **New England Medical Center:** New England Medical Center's ten-year master plan, dated 1990, includes the development of additional clinical and research space totaling over 700,000 square feet in four buildings. A major goal of the plan is to consolidate facilities. The first phase of development ***under construction since the fall of 1992*** includes a 250,000 net square foot in-patient ambulatory and clinical building on Washington Street and expansion of the Herald Street parking garage.

- **Tufts University Health Science School:** Tufts University's long-range expansion plans include growth in facilities for science research, bio-engineering, and patient diagnosis and treatment. Potential development sites include the Posner Lot on Harrison Avenue, Posner Hall on Harrison Avenue and Oak Street, and the R-1 Parcel on Tyler Street.

3.2.4 Midtown District

Each alternative will pass through portions of the Midtown District. This district is composed of three distinct areas — Downtown Crossing, Park Square, and the Theatre District. The Downtown Crossing area of the Midtown District is generally bordered by City Hall Square to the north, Essex Street to the south, the Financial District to the east, and Tremont Street to the west. The Park Square/Theatre District area is generally bordered by the Boston Common/Boston Public Gardens to the north, the Massachusetts Turnpike to the south, Chinatown to the east, and the Back Bay and South End to the west. Given their similar demographics, land uses, and economies, Park Square and the Theatre District will be discussed together in the following sections.

3.2.4.1 Neighborhoods

Demographics

Given its inclusion in a larger BRA planning district, demographics specific to the Midtown District are not easily isolated. Demographics cited below are taken primarily from the BRA's 1989 plan for the district.

Despite its proximity to open space, mass transit facilities, and downtown employment opportunities, only about 2,500 people live in the Midtown District. Most of these residents also work in the area. District residents are predominantly middle-aged adults with a median age of 39.2 in 1980. Very few children live in the district. As a result of this age mix, household size tends to be quite small, averaging less than two persons.

The problem of homelessness is also very serious within the district. While there is no figure on the number of homeless people living in the district, seven soup kitchens in and near the district serve about 4,900 meals a week, approximately one-fifth of the free meals served each week in Boston.

Housing

Although parts of the Midtown District were popular residential areas in the late eighteenth and early nineteenth centuries, the district's importance as a residential community waned in the mid-nineteenth century. Approximately 1,400 units of housing in seven buildings provide homes to current residents. Most of these units consist of subsidized and elderly housing. Since 1984, only 224 of the more than 11,000 new units of housing built in the city have been built in the Midtown District.

Neighborhood Cohesion

The lack of a significant residential population in the Midtown District has led to a very low level of neighborhood cohesion. The Downtown Crossing Association, which addresses neighborhood concerns of downtown merchants as well as residents, is the major resident organization in the district.

3.2.4.2 Land Use and Economic Activity

The Midtown District has a 200-year history as the regional center for the arts, recreation, and city life. Centrally located in the middle of downtown Boston's business and residential communities, the district stretches from the edges of Boston Common to Downtown Crossing, the Combat Zone, the Theatre District, and Park Square. Each business day more than 300,000 people work, live, shop, or visit the one-square mile area which includes and surrounds the district. Many resources — such as Government Center, the Financial District, Copley Square, Chinatown, Bay Village, Beacon Hill, the Fanueil Hall Marketplace, and the Charles River Esplanade — are within a ten-minute walk. In addition, three of the region's four subway lines stop in the district, the South Station commuter rail station is within walking distance, and Logan Airport is only a subway ride away.

Downtown Crossing is Boston's major retail district consisting of Filene's, Jordan Marsh, the Mall at Downtown Crossing, and numerous other stores located along Washington Street. Other commercial uses, primarily retail shops and restaurants, are located on the first floors of five- to ten-story buildings located along the streets connecting Washington and Tremont Streets (*e.g.*, Temple Street, Winter Place, Bromfield Street, and School Street). The top floors of the majority of these buildings contain office uses. In the vicinity of Downtown Crossing, both Winter Place/Summer Street and Washington Street between Temple and Bromfield Streets are auto-restricted zones providing open space for pushcart vendors and pedestrian traffic.

Major new construction projects in the Downtown Crossing area over the past several years include 99 Summer Street, a 20-story office building; 125 Summer Street, a 23-story office building with first floor commercial use located on the block bordered by Summer, South, and Lincoln Streets; and 101 Arch Street providing direct access to the Downtown Crossing Red and Orange Line Station. Recently renovated was 600 Washington Street, a seven-story office building with first floor retail and commercial use and a public entrance/exit to the Chinatown Orange Line Station. This building is situated on the block bordered by Washington Street, Essex Street, Harrison Avenue, and Hayward Place.

The Park Square/Theatre District is an area that has historically housed the music and theater industry. The Theatre District is the home of the Schubert, Wilbur, and Colonial Theaters, the Charles Playhouse, the Wang Performance Center, as well as resident theater companies. Other uses include music shops and showrooms and, more recently, uses such as office, commercial, and retail. The area is characterized by six- to twelve-story granite structures.

Major new construction in the Park Square/Theatre District within the last several years has included: the State Transportation Building housing state agencies and first floor retail and commercial uses; the Four Seasons Hotel providing approximately 300 hotel rooms in addition to retail and restaurant/lounge facilities; Heritage-On-The-Garden, which provides luxury condominiums and first floor retail/commercial space on the corner of Arlington and Boylston Streets; and Parkside, a retail/residential development project located on Tremont Street next to the Tremont-on-the-Common condominium building. Major land uses located in the Midtown District are shown in Figure 3-8 and listed in the following Table 3-8.

3.2.4.3 Proposed Development Goals

Proposed revitalization of the Midtown District is aimed at creating a vibrant mixed-use economy consisting of cultural facilities, housing, offices, shops, and restaurants in new and renovated buildings. Strategies for achieving this goal include directing downtown office uses into currently underutilized areas, enhancing the city's retail core, encouraging neighborhood-oriented businesses, strengthening the area's existing entertainment and visitor sections, and ensuring that neighborhoods share in the economic benefits accruing from district revitalization.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-8
Land Use
Midtown District

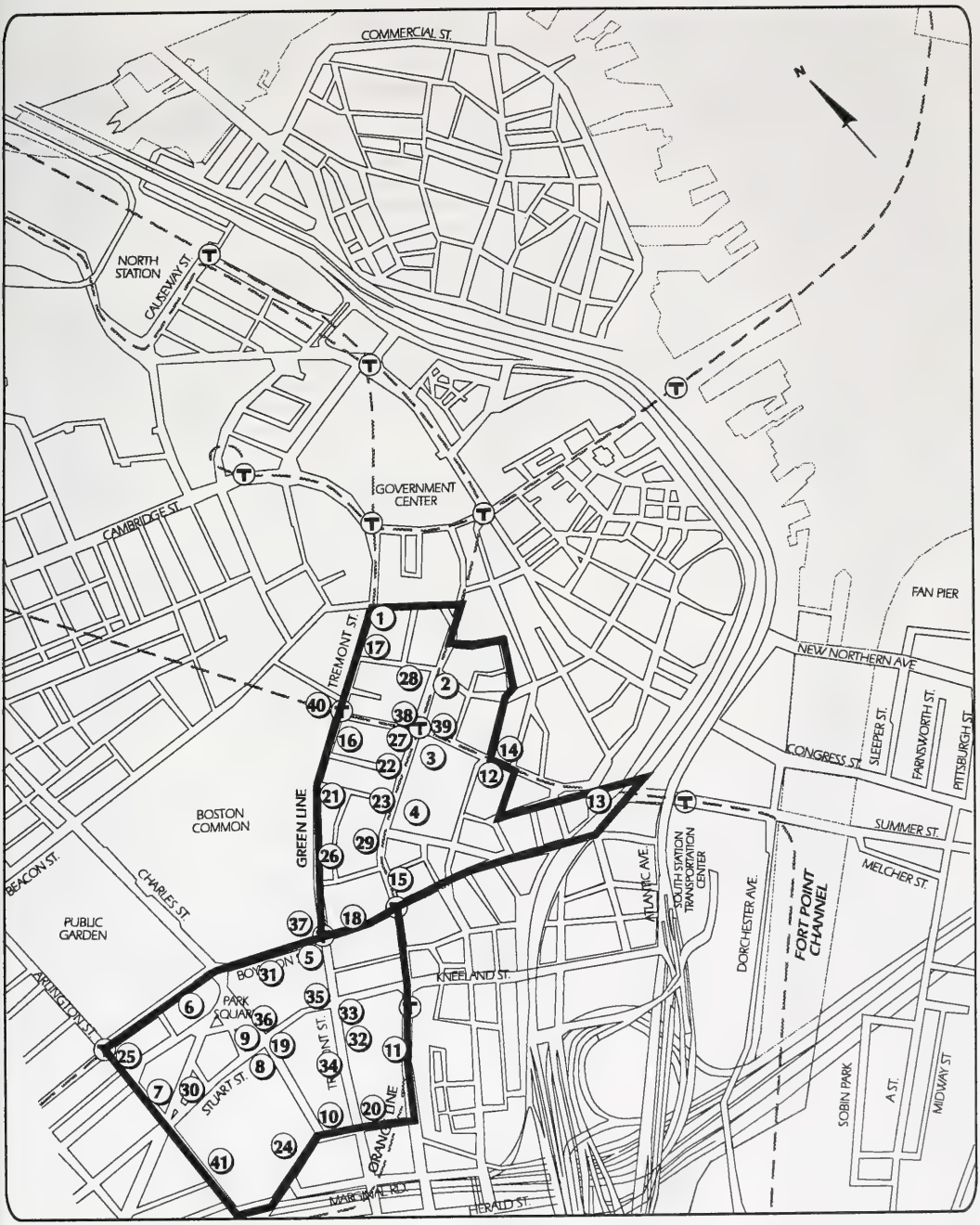

TABLE 3-8: MAJOR LAND USES IN THE MIDTOWN DISTRICT

Type	Map Number	Facility Description
Commercial	1	Parker House Hotel - 16-story hotel with first floor retail and commercial use
	2	Filene's Department Store
	3	Jordan Marsh Department Store
	4	Lafayette Place
	5	The Little Building - Professional and state offices with first floor retail and commercial use
	6	Four Seasons Hotel - 12-story hotel with first floor restaurants and lounge areas
	7	Boston Park Plaza Hotel and Statler Office Building - 12-story granite building with hotel located on Arlington Street side of the building, office use on Charles Street side, and first floor retail/commercial use
	8	57 Park Plaza Hotel and USA Cinema
	9	6-story structured parking garage
	10	Tremont House
	11	Theatre District Parking Garage
	12	99 Summer Street - 20-story office building
	13	125 Summer Street - 23-story office building with first floor commercial uses
	14	101 Arch Street - professional office building with a direct connection to the Downtown Crossing Station
	15	600 Washington Street - 7-story office building with first floor retail and commercial use and an entrance to the Chinatown Orange Line Station
Institutional	16	St. Paul's Cathedral
	17	Tremont Temple Baptist Church
	18	Grand Lodge of Masons
	19	New England School of Law
	20	Don Bosco Technical High School
Residential	21	Tremont-on-the-Common
	22	Stearns Building - Elderly Housing
	23	Mason Place - Elderly Housing
	24	Bay Village District
	25	Heritage-on-the-Garden - Luxury condominiums
	26	Parkside - Luxury condominiums with first floor retail and commercial space

TABLE 3-8: MAJOR LAND USES IN THE MIDTOWN DISTRICT (continued)

Type	Map Number	Facility Description
Cultural/Recreational	27	Downtown Crossing/Winter Place - Auto-restricted pedestrian way
	28	Loew's Orpheum Theater
	29	Boston Opera Company - Seats 2,300
	30	Statler Park
	31	Colonial Theater
	32	Wang Performance Center
	33	Wilbur Theater
	34	Shubert Theater
	35	Saxon Theater
Public Facilities	36	State Transportation Building
	37	MBTA Green Line/Boylston Station
	38	Massachusetts Department of Environmental Protection (DEP) Offices
	39	MBTA Orange and Red Line/Washington Street Station
	40	MBTA Green and Red Line/Park Street Station
	41	University of Massachusetts Building

Sources: Federal Highway Administration, *Land Use, Community Facilities and Economic Activity Report*, June 1983.

City of Boston, Topographic and Planimetric Survey Maps, 1986.

Key development projects proposed for the Midtown District are described briefly as follows:

- **Hinge Block (Stuart, Tremont, Washington and Boylston Streets):** ***This block has been planned and zoned to accommodate new development. Future potential uses include an expansion of the New England Medical Center (research and ambulatory care) or Emerson College (academic use), affordable housing, a cultural facility, and open space.***

- **Parcel 30/Keith Block (Boylston, Tremont, Avery and Washington Streets):** All structures on this parcel were recently demolished leaving a vacant site ready for development. Proposals for the site are generally for mixed-use development. Recent ideas include ***retail, cinema, and hotel space*** and a combination of market rate and affordable housing. In the interim, the site is being used for surface parking, providing the Midtown District with an additional 500 spaces.

- **Lafayette Place II (Washington Street and Avenue de Lafayette):** ***Plans for a $100 million renovation of Lafayette Place, including new access and some demolition, are underway. Once the developer is selected (this decision is expected in late 1993), the project will be completed in one to two years. Plans for the Hayward Parcel (bordered by Hayward Place, Washington Street, Avenue de Lafayette, and Harrison Avenue) contain a possible hotel/residential component.***

3.3 TRANSPORTATION

Existing transportation conditions in the South Boston Piers Transit Project area are discussed in this section.[3] Potential impacts on these transportation conditions caused by the project alternatives are described in Chapter 4.

3.3.1 Transit Services

3.3.1.1 South Boston Piers/Fort Point Channel Area

Three MBTA local bus routes currently serve the Piers area. These routes are shown in Figure 3-9. Table 3-9 provides route headways and service statistics.

Route 7 is the major route passing through the Piers area between its termini at City Point in residential South Boston and Federal Street in downtown Boston. The primary market served by Route 7 consists of riders from City Point traveling to the Financial District and other areas of downtown Boston. In the reverse direction, this route carries riders from downtown to the Piers area and industrial South Boston. Frequent stops are provided along the entire route, but there are no fixed facilities at the intermediate stops other than occasional shelters. Service is provided six days a week from 5:15 a.m. to 10:30 p.m. using standard MBTA buses. Wheelchair lift-equipped buses are available on request through the MBTA's Call-a-Lift Bus Program.

[3] A more complete description of existing transportation conditions is provided in *Report No. 19: Transportation Methods and Results* (MBTA, October 1992).

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-9
Existing Transit Service In the Project Area

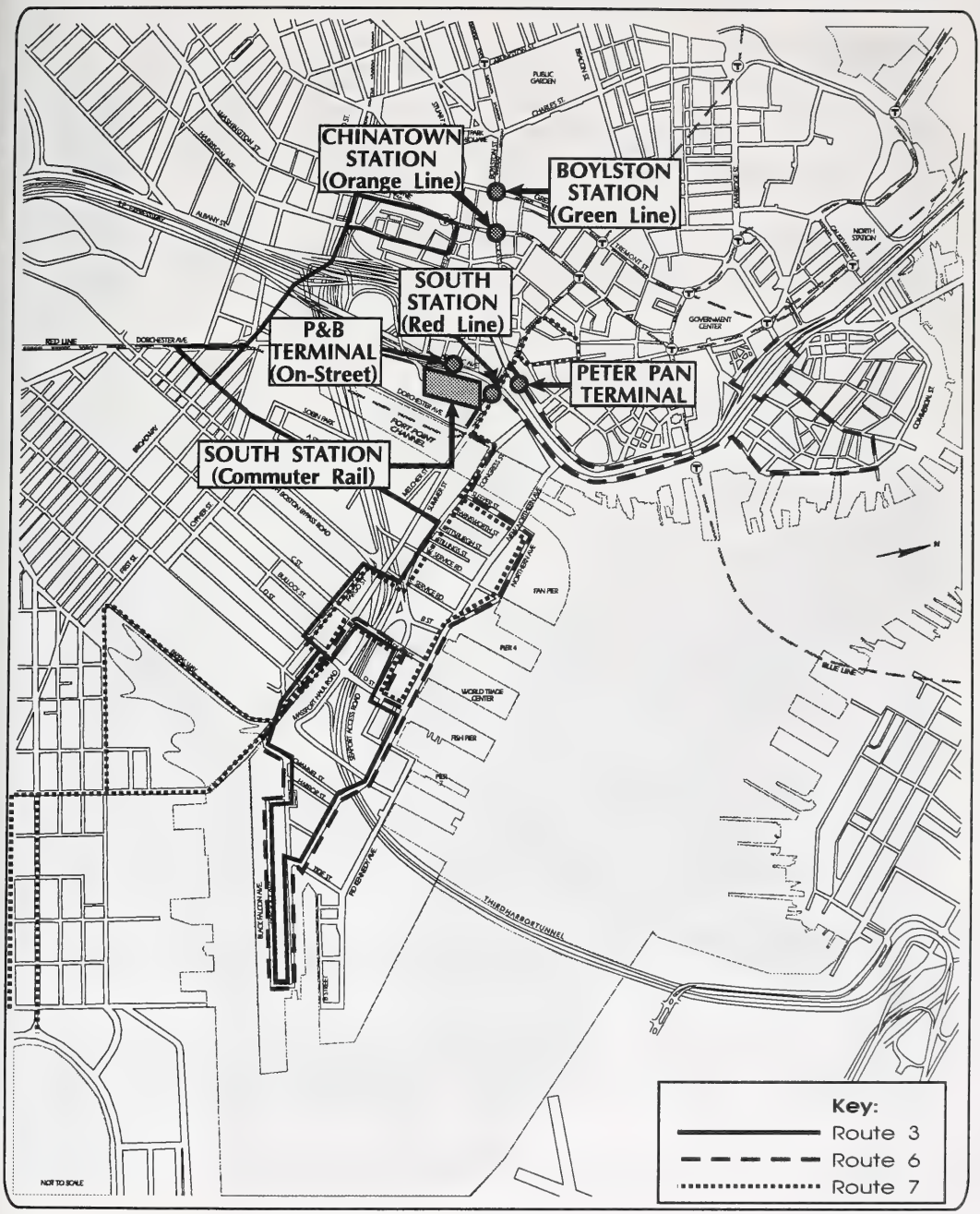

TABLE 3-9: PIERS AREA MBTA BUS ROUTES SERVICE STATISTICS

Route	Headway *	Number of Buses	Cycle Time*	Round Trip Route Length	Round Trip Running Length	Average Schedule Speed
Peak						
3 Chinatown-BMIP	20/22	2	40/45	5.5	38	8.7
6 Haymarket-BMIP	30	2	60	8.6	49	10.5
6 South Station-BMIP	15**	1	30	4.8	21	13.7
7 City Point-Downtown	12/14	5	60/70	8.6	43	12.0
Off-Peak						
7 City Point-Downtown	25	2	50	9.0	39	13.8

* a.m. peak/p.m. peak
** includes service from Haymarket

Source: MBTA Operation Directorate

Route 7 serves approximately 2,100 riders per day. In the morning peak period, ridership is split with about 60 percent in the direction of the primary market (residential South Boston to downtown) and 40 percent in the direction of the secondary market (downtown to the Piers area and the adjacent industrial area). About one-third of the primary market that crosses the channel is destined for the South Station area while two-thirds continue on to stops on Franklin and Otis Streets. The destinations of the secondary market riders tend to be along Summer Street or in the Harbor Industrial Park, with very few along Northern Avenue. The origins of these riders are evenly split between those boarding at South Station and those boarding on Otis Street in the Financial District. The Otis Street boardings most likely involve transfers from other services, particularly the Orange Line.

Route 6 connects BMIP and much of the rest of the Piers area to South Station (providing connections to the Red Line, commuter rail, and private express bus services), Aquarium Station (Blue Line), the North End, and Haymarket Square (Green and Orange Lines). Stops are frequent and some shelters are provided along the route. The only fixed facility, however, is the Haymarket Square Terminal. Wheelchair lift-equipped buses provide all service on this route which operates only on weekdays for four hours during the peak period.

Route 6 serves about 900 riders per day. In the morning, 85 percent of the riders are destined for the Piers area, with the rest making local trips downtown. Of the Piers riders, 70 percent board at South Station. The remaining 30 percent board at Haymarket or in the North End. In the Piers area, most destinations are within BMIP.

Route 3 connects BMIP to Broadway Station (Red Line), New England Medical Center Station (Orange Line), and the Chinatown neighborhood. Stops are generally frequent, but no fixed facilities are provided. Service is provided only on weekdays during peak periods using wheelchair lift-equipped buses.

Route 3 serves about 300 riders per day. Only slightly more than half of the morning outbound riders board in the downtown area. The rest board at Broadway Station (presumably transferring from the Red Line). Most destinations in the Piers area are along Summer Street or within BMIP.

In addition to these public transportation services, there are three privately operated shuttle bus routes to developments in the Piers area. Only one of these services — the World Trade Center shuttle — is open to the general public. This shuttle, which is financed by the World Trade Center and operated by the Boston Coach Company, runs between South Station and the World Trade Center and makes no intermediate stops. Service is provided free of charge every day from 6:00 a.m. to 7:00 p.m. using three mini-buses operating at approximately 7-minute headways. On days with no special events, approximately 1,500 riders use this service. For special events at the World Trade Center, additional service is provided.

The two other privately operated shuttle services are not open to the general public. A service for employees of Fidelity Investments is operated between their World Trade Center offices and North, Haymarket, and State Street Stations. The Boston Design Center, located at BMIP, also provides a shuttle service for its employees and clients (with identification) from South Station.

3.3.1.2 Downtown

The downtown portion of the project area is well served by much of the MBTA's transit system. As shown previously in Figure 3-8, many of the major radial transit services pass through downtown. Those that serve South Station (the South Side commuter rail, private carrier express buses, and the Red Line) pass close enough to the Fort Point Channel that passengers destined for the western edge of the Piers area can walk to their destinations. For those passengers with destinations further east in the Piers area, transfers to MBTA and private shuttle buses are available at South Station. At the western end of the service area, Boylston Station provides Green Line access, and stops on the Orange Line are available at Chinatown and New England Medical Center Stations. Passengers on the Green and Orange Lines must transfer to a local bus to reach the Piers area. Each of these radial services is discussed below.

South Side Commuter Rail

The five commuter rail lines terminating at South Station make up the MBTA's South Side commuter rail service. The Framingham Line parallels the Massachusetts Turnpike to the west. The Needham, Franklin, and Attleboro/Stoughton Lines parallel the Orange Line through the Southwest Corridor to Forest Hills, where the Needham Line branches off to serve stations in the West Roxbury section of Boston and in Needham. The Franklin and Attleboro/Stoughton Lines largely serve suburban areas further to the southwest. The Fairmount Line serves stations within the city of Boston along the Midlands Branch in Dorchester, Mattapan, and Hyde Park. With the exception of the Fairmount Line, all of the South Side lines also serve Back Bay Station.

There are forty-seven stations served by South Side trains. (Of these, seventeen are wheelchair accessible, including South Station.) Convenient indoor transfers are provided to the Red Line at South Station and the Orange Line at Back Bay Station. Passengers can transfer to outbound Routes 6 and 7 at South Station without crossing the street, but transfers from inbound Routes 6 and 7 to the rail station either require the crossing of busy Summer Street or the use of the Red Line stairways and mezzanine. The western edge of the Piers area is generally within walking distance of South Station via the Summer Street and Congress Street bridges.

Peak headways on the five rail lines are typically about 30 minutes, with the Attleboro and Stoughton branches combining to provide more frequent service between Canton Junction and South Station. Train lengths vary, with some trains operating with the maximum nine cars. The recent purchase of additional commuter rail coaches and the introduction of bi-level coaches has provided the capability to increase capacity up to and beyond existing demand.

South Side commuter rail ridership expanded dramatically in the 1980s to a daily average of 21,890 inbound riders in 1989. This is more than a doubling of ridership in five years over the 1984 daily average

of 9,891.[4] Substantial ridership growth has been seen on all lines, with the Attleboro/Stoughton Line showing the largest gain. Much of the ridership gain has been attributed to increases in capacity on the commuter rail system, including expanded parking and new coaches, that attracted riders previously discouraged by overcrowding and lack of parking. Extensive reconstruction of the physical plant, including major renovation of South Station, has also contributed to ridership growth.

Private Carrier Commuter Express Bus Service to South Station

Fifteen private carrier commuter express bus operators provide service to the South Station area. Most of these serve one of the two terminals located near the railroad station. The largest carrier, Plymouth & Brockton Street Railway Company, operates from an outdoor facility off Atlantic Avenue adjacent to the South Station railroad platforms. Plymouth & Brockton primarily serves communities on the South Shore and Cape Cod. Several smaller carriers also use their terminal. The other major terminal is the Peter Pan Bus Terminal on the west side of Atlantic Avenue, north of Summer Street. It includes a climate controlled terminal building and is served by Peter Pan Bus Lines from Framingham and Worcester, American Eagle from New Bedford, and other carriers. Despite the existence of these two terminals, some smaller carriers instead make on-street stops in the vicinity of South Station.

Most carriers at South Station originate service in suburban areas to the south of Boston, although there are some carriers from the west and north. Most carriers from the north, however, do not provide service to South Station, serving instead only the Haymarket/North Station and Back Bay/Park Square areas. The majority of the carriers serving the South Station area also serve one or more on-street stops in Back Bay/Park Square. Ridership to Back Bay and Park Square is significant, but the majority of riders use stops near South Station. Bonanza, the second largest private carrier of commuters, originates in areas to the south of Boston; only one on-street stop is provided in the downtown area, at Back Bay Station.

Both bus terminals at South Station are within a short walk of MBTA Routes 6 and 7. Walking to or from the Peter Pan Bus Terminal requires crossing Atlantic Avenue in either direction and Summer Street in one direction. Access to the Plymouth & Brockton terminal requires only the crossing of Summer Street in one direction.

The level of service differs substantially between carriers with some small carriers providing as little as one trip per day in each direction. In contrast, Plymouth & Brockton provides an average peak headway under 10 minutes from its Rockland park-and-ride, and Peter Pan provides 15-minute peak headways from its Shoppers' World park-and-ride in Framingham. Some private carriers that are subsidized by the MBTA operate wheelchair lift-equipped buses.

Peak period (2 p.m. to 6 p.m.) ridership on the fifteen carriers serving the South Station area was estimated at 3,300 in 1989, but not all of these passengers boarded at South Station.[5] Peak period load factors on services to the south averaged thirty-two passengers per trip although peak hour loads probably exceed that figure.

Red Line Rapid Transit

The Red Line serves the northwest and southeast corridors, extending from Alewife Station on the Cambridge/Arlington line to Columbia Junction where it branches and continues to two southern terminals

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[4] The 1984 data does not include the Needham and Fairmount Lines. The Needham Line was temporarily closed in 1979 for reconstruction with replacement service provided by express buses. Fairmount Line service began in 1979 as a mainline detour route during Southwest Corridor construction. Following the opening of the Southwest Corridor in 1987, some service was kept on the Fairmount Line as a separate route. The 1989 daily inbound ridership, excluding the Needham and Fairmount Lines, averaged 18,269, up 84 percent from 1984.

[5] MBTA, *Draft Bus Terminal Study*, March 1991.

— Ashmont Station in the Dorchester section of Boston and Braintree Station in the South Shore suburb of Braintree. The line includes subway, surface, and elevated trackage.

There are six stations northwest of downtown in Cambridge and Somerville, four in downtown Boston, and twelve stations to the south in the South Boston and Dorchester sections of Boston and in the suburbs of Quincy and Braintree. Fifteen of the twenty-two stations, including South Station, are wheelchair accessible. Free transfers are provided to the Green and Orange Lines at Park Street Station and Downtown Crossing, respectively; the Red and Blue lines do not directly intersect. An indoor connection to the South Station railroad terminal concourse was recently opened, and a new stairway has been provided to the street near the Peter Pan Bus Terminal across from South Station. At South Station, the Peter Pan Bus Terminal, the Plymouth & Brockton express bus loading area, and the MBTA local bus stops for Routes 6 and 7 can all be reached without crossing automobile traffic. Route 3 can be boarded at Broadway Station.

Peak headways are 7 minutes on each branch, for a combined 3.5-minute headway between Alewife and JFK/UMASS Stations. Peak service is provided primarily with six-car trains although some four-car trains are still operated. By the end of 1992, all peak service will be provided with six-car trains. As shown in Table 3-10, the current peak hour line capacity is estimated by the MBTA to be approximately 12,000 (7,100 to Braintree and 4,900 to Ashmont). Off-peak headways are 12 minutes on each branch and are operated with four-car trains.

TABLE 3-10: CURRENT RAPID TRANSIT LINE CAPACITY A.M. PEAK HOUR

Line	Cars Per Hour	Peak Headway	Cars Per Peak Hour	Design Load Per Car	Effective Line Capacity*	1989 Peak Load	1980 Load Factor
Red	4-6	3.5	88	160	11,968	9,132	76%
Orange	6	4.6	78	130	8,619	7,379	86%
Green	1-3	1.3	90	110	7,920	NA	NA
Blue	4	3.0	80	95	6,460	6,389	99%

* Because of variability in the schedule, effective capacity is less than design load times the number of cars per hour. MBTA research has developed an adjustment factor of 85 percent for the Red, Orange, and Blue Lines, and a factor of 80 percent for the Green Line.

Source: MBTA Operations Directorate

The Red Line has the second highest total ridership of the MBTA's four rail transit lines but has the highest peak loads. In 1989, in the a.m. peak hour, 5,417 riders arrived at the peak load point at Broadway Station on Braintree trains while 3,715 arrived on Ashmont trains. This indicates load factors of 76 percent of design capacity on each of the two branches.

Orange Line Rapid Transit

The Orange Line serves the north and southwest corridors, extending from Oak Grove Station on the Malden/Melrose line to Forest Hills Station in the Jamaica Plain section of Boston. The southern half of the line was relocated in 1987 from an elevated structure over Washington Street to a part subway, part

open-cut, alignment referred to as the Southwest Corridor. The entire line includes subway, surface, and limited elevated trackage.

There are five stations north of downtown in the Charlestown section of Boston and in the suburbs of Medford and Malden; eight stations in downtown Boston and Back Bay; and six stations to the southwest in the Roxbury and Jamaica Plain sections of Boston. Thirteen of the nineteen stations are wheelchair accessible. Free transfers are provided to other rapid transit lines at Haymarket and North Stations (Green Line), State Street (Blue Line), and Downtown Crossing (Red Line). Passengers can transfer to buses destined to the Piers area at Haymarket (Route 6) and at New England Medical Center Station (Route 3).

Peak headways are roughly 5 minutes, and peak service is provided with six-car trains. Each six-car train has a design capacity of 780 passengers. As shown previously in Table 3-10, the adjusted peak hour line capacity is estimated by the MBTA to be approximately 8,600 passengers per hour. Off-peak headways are 8 minutes and are operated with four-car trains. The Orange Line has the third highest total ridership of the four rail transit lines. In 1989, in the a.m. peak hour, 7,379 riders arrived at the peak load point north of North Station, indicating a load factor of 86 percent of the adjusted line capacity.

Green Line Light Rail System

The Green Line is a light rail system consisting of a central subway and four branches encompassing a variety of operating conditions. The longest branch is the Riverside Branch (D Line) operating from Riverside Station near Route 128 (I-95) in Newton less than one mile from the Massachusetts Turnpike. It operates in a grade-separated former railroad right-of-way through Newton and Brookline. The Boston College Branch (B Line) operates in a center reservation on Commonwealth Avenue in the Allston/Brighton section of Boston, while the Cleveland Circle Branch (C Line) operates in a center reservation on Beacon Street in Brookline. Both of these branches cross automobile traffic at numerous intersections. The Riverside, Boston College, and Cleveland Circle Branches pass underground and merge to begin the Central Subway at Kenmore Station. The fourth branch (E Line) begins at the Arborway yard near Forest Hills Station in the Jamaica Plain section of Boston and operates in mixed traffic with automobiles as far as Brigham Circle on Huntington Avenue where a center reservation begins. It enters a subway after Northeastern University and merges with the Central Subway at Copley Square. (Service on the Arborway Branch is currently suspended south of Heath Street, approximately one mile outbound from Brigham Circle, pending a decision on restoration of service. A fifth branch, the A Line to Watertown, was discontinued in 1969 although the trackage remains in place.) The Central Subway surfaces at North Station and the Green Line continues above ground to Lechmere Station in East Cambridge.

A total of sixty-nine currently active stops are served by the Green Line, including numerous surface station stops on each of the four branches. Because of the low platforms and high floor vehicles with steps, the Green Line is not wheelchair accessible. The Central Subway has two stations west of Copley Square where the Arborway branch joins. The Arborway branch also has two subway stations of its own west of this junction. All four branches serve Copley, Arlington, Boylston, and Park Street Stations in the Central Subway. Because of the numerous turnbacks provided north of Park Street, not all branches serve all of the five stations north of Park Street. Each branch normally has a distinct inner terminus; *e.g.*, cars originating at Boston College might terminate at Government Center, while Cleveland Circle cars might terminate at North Station. This pattern has changed frequently over the years.

Free transfers to the rapid transit lines are provided at Park Street (Red Line), Government Center (Blue Line), and Haymarket and North Stations (Orange Line). The only direct transfer available to a bus serving the Piers area is to Route 6 at Haymarket Station. For the majority of Green Line riders who come from the west, however, this route would be very circuitous and time consuming. Moreover, some branches may not even have direct service to Haymarket due to the various turnback locations for each branch. Most riders to the Piers area currently either transfer to the Red Line at Park Street and then transfer to Route 6 or 7 at South Station, or undertake a walk of several blocks from Park Street Station to board the Route 7 bus at Otis Street.

Peak headways range from 5 to 8 minutes depending on the branch. Headways in the Central Subway between Copley and Park Street average about 1.3 minutes although the headway varies considerably and bunching is common. Trains operate either as single units or as two or three car combinations. Power capacity improvements underway will provide the capacity for additional three car trains. Service is operated primarily using Boeing LRV and newer Type #7 LRV equipment. Both have a seated capacity of fifty-two and a design capacity of 110. As shown previously in Table 3-10, at current scheduled service levels, a peak hour adjusted capacity of approximately 7,900 passengers is provided on the common section of the Central Subway between Copley and Park Street Stations.

The Green Line has the highest total ridership of the four rail transit lines although actual ridership varies from day to day because of college schedules and sporting events at Boston Garden and Fenway Park. While actual peak load counts for the Green Line are not available, CTPS model simulations indicate that loads tend to be less peaked and less directional than on other lines due to the nature of Green Line ridership. The Green Line serves as a downtown distributor for the Red and Blue Lines and for commuter rail and express bus services from the north. Almost half of Green Line riders transfer from a rapid transit line, commuter rail line, or bus route. This results in many short trips within the downtown area and loads that remain fairly consistent between Kenmore Square and Park Street. Eastbound peak loads in the Central Subway in the a.m. peak period tend to be only slightly greater than westbound loads.

3.3.2 Highway System and Street Network

3.3.2.1 South Boston Piers/Fort Point Channel Area

The South Boston Piers area is served by two east-west arterials — Northern Avenue in the north of the area and Summer Street in the south — that begin in the CBD and traverse the area to its eastern edge at BMIP. Both arterials enter the area via bridges across the Fort Point Channel, as does Congress Street which terminates roughly in the middle of the area. Summer Street is on a viaduct through part of the area, providing a connection by means of Viaduct Street to the upper level of the World Trade Center. Local roadways such as A, C, and D Streets provide access from the south. The existing street network in the Piers area was shown previously in Figure 1-5.

3.3.2.2 Downtown

The Boston metropolitan area highway network, shown in Figure 3-10, includes a number of key radial and circumferential elements. The central element of the regional highway system is Boston's Central Artery. Part of Interstate 93 and U.S. Route 1, the Central Artery forms the core of the regional highway system and connects all major radial highways entering Boston. As the major north-south access route through downtown Boston, the Central Artery is also a primary route to the Piers area from most radial corridors.

The major radial routes into Boston are as follows (from north to south):

- U.S. Route 1A, serving the northeast corridor, enters downtown via the Sumner/Callahan Tunnels and terminates at a surface street connection with the Central Artery (I-93/Route 1)
- Northeast Expressway (U.S. Route 1), serving the northeast corridor, enters downtown via the Tobin Bridge and merges with I-93 to form the Central Artery
- I-93 (north of Boston), serving the north corridor, becomes the Central Artery after its junction with the Tobin Bridge (U.S. Route 1)
- Massachusetts Turnpike (I-90), serving the west corridor, terminates at the Central Artery (I-93/Route 1) in downtown Boston
- Southeast Expressway (also designated I-93, U.S. Route 3), serving the southeast corridor, becomes the Central Artery in downtown Boston

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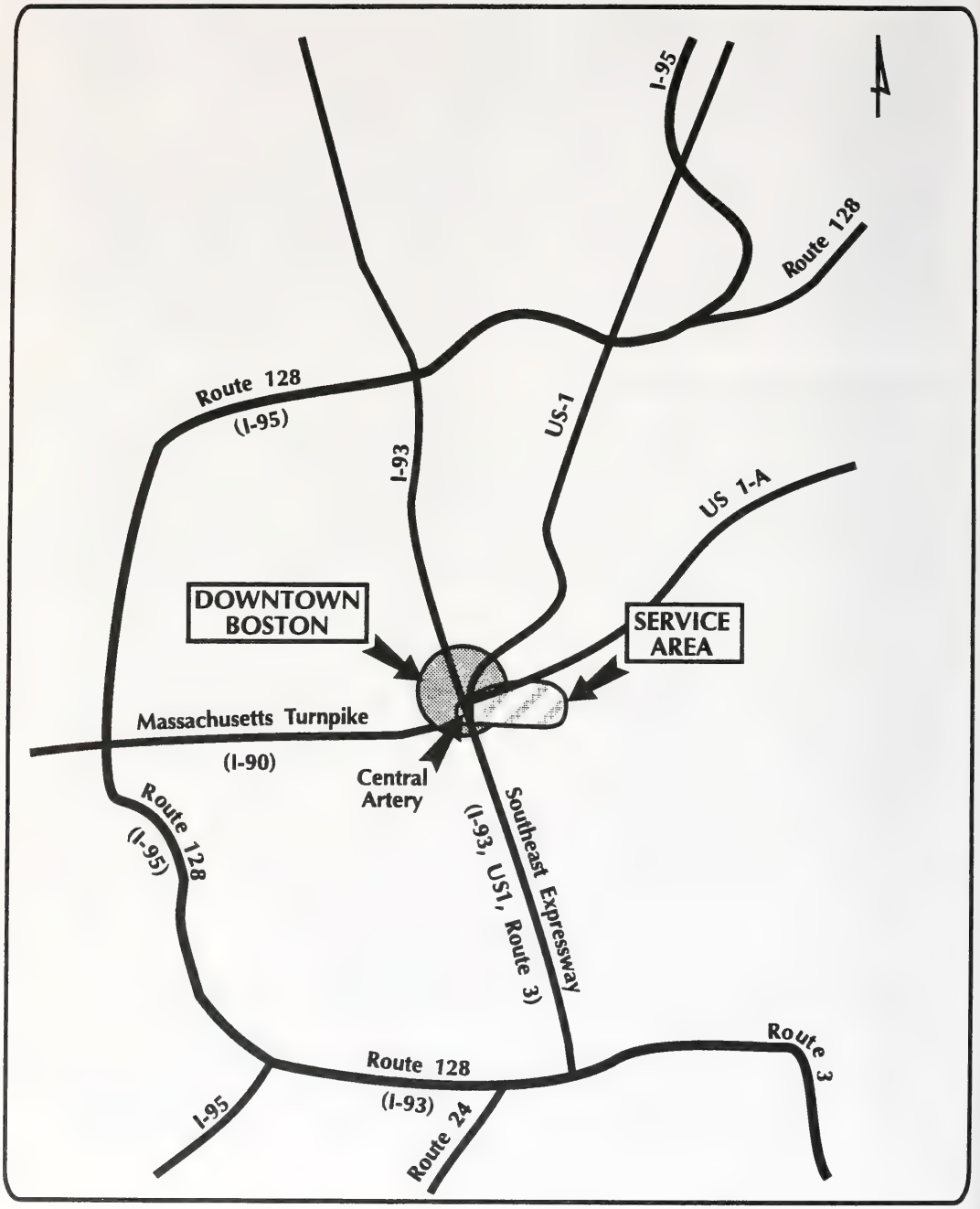
South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-10
Boston Area
Highway Network



The primary circumferential highway is Massachusetts Route 128, serving major suburban communities within a radius of 10 to 15 miles of downtown Boston. Most of Route 128 is also designated I-95, while the southern end is designated I-93.

Three east-west arterials traverse the South Station area: Summer Street, Congress Street, and Northern Avenue. These arterials cross the Fort Point Channel via bridges to the South Boston Piers area. Atlantic Avenue provides north-south service through the South Station area, intersecting with all three east-west arterials.

The Chinatown/Leather District is intersected by several major arteries providing crosstown access and connections to the regional highway system. These streets include Essex Street, the Surface Artery, Kneeland Street, and Tremont Street.

Although the Midtown District is easily accessed by automobile from Storrow Drive, the Massachusetts Turnpike, the Central Artery, and the Southeast Expressway, this access is not matched by an easily used network of arterial streets. The district's major east-west arteries are Stuart/Kneeland and Boylston/Essex Streets. However, Essex Street is one-way, allowing only east-bound travel. Charles Street is the major northbound artery, while Chauncy and Washington Streets carry some northbound traffic. Washington Street's northbound arterial role is restricted by the presence of the Downtown Crossing pedestrian mall. Tremont Street is the major southbound artery, while Bedford Street, Chauncy Street, one block of Washington Street, and Avenue de Lafayette also provide some westbound and southbound service.

3.3.3 Traffic Volumes and Congestion

3.3.3.1 South Boston Piers/Fort Point Channel Area

Significant traffic congestion presently occurs at numerous locations in the Piers area, particularly along the three arterials linking the area to downtown. According to analysis conducted for the CA/T Project, many of the key intersections of Congress Street and Northern Avenue suffer severe congestion. For example, the Congress Street/A Street and Northern Avenue/Sleeper Street intersections were found to operate at an unacceptable level of service (LOS) in both the a.m. and p.m. peak hours. In the p.m. peak, the Northern Avenue/Sleeper Street intersection operates at LOS F, with turning movements from Sleeper Street onto Northern Avenue characterized as particularly difficult. High volume-to-capacity ratios plague both intersections in the p.m. peak, hindering the movement of traffic between the Piers area and downtown. The situation is worsened by the poor operating conditions of the Congress Street/Dorchester Avenue and Congress Street/Atlantic Avenue intersections. Operating conditions along Summer Street, particularly at its intersections with Atlantic Avenue and Dorchester Avenue, are also poor. The intersection of Summer Street and Atlantic Avenue operates at LOS E in both the a.m. and p.m. peak hours.

3.3.3.2 Downtown

The Central Artery is the major north-south access route through downtown Boston, handling the highest traffic volumes of any route in the area. However, at over 175,000 vehicles per day, volume exceeds design capacity by 100 percent. As a consequence, congestion plagues the Central Artery at most times of the day and is especially severe during peak periods.

On local streets in downtown, traffic conditions have historically been a function of an irregular street pattern poorly suited for vehicular travel. This problem is exacerbated by the loading and unloading of service vehicles and illegal parking.

In the South Station area, significant traffic congestion occurs along Atlantic Avenue at its intersections with the three arterials connecting downtown and the Piers area. The intersections of Atlantic Avenue and Summer Street, Congress Street, and Northern Avenue operate at LOS E or F in the peak hours.

Traffic congestion varies throughout the Chinatown/Leather District, with the highest levels occurring in the commercial area north of Kneeland Street. Gridlock conditions in and around this area cause trip diversion through the commercial core, on streets such as Beach Street and Harrison Avenue.

Four of the Midtown District's five worst intersections are located on the Boylston/Essex corridor: at Charles Street, Tremont Street, Washington Street, and Chauncy Street/Harrison Avenue. The fifth problem intersection is at Stuart and Tremont Streets, where east-west traffic merges with southwest-bound traffic. Congestion in the district is amplified by a confusing network of one-way streets, loading zones, parking lanes, and turning lanes.

3.3.4 Parking

3.3.4.1 South Boston Piers/Fort Point Channel Area

The Piers area is characterized by low-density development with many vacant lots that provide surface parking to both commuters and visitors to the area. On the western edge of the area, this parking is used primarily by downtown commuters who walk to their final destinations via one of the bridges over the Fort Point Channel. Spaces in these downtown-oriented commuter parking lots are substantially less expensive than the structured spaces that predominate on the downtown side of the channel. For example, in 1991, the all-day rate at Fan Pier was $6.00 compared to rates of $20.00 at International Place and $18.00 at Rowes Wharf. The BRA's *Fort Point Channel District Plan* (June 1987) references 12,761 spaces north of First Street, with 22 percent of this parking used by downtown commuters. A recent CTPS inventory indicated 8,615 off-street parking spaces currently in the Piers area north of Summer Street.

3.3.4.2 Downtown

Downtown Boston, including the downtown portion of the service area, is a densely developed business area where nearly all off-street parking is structured. Downtown Boston is subject to an off-street parking freeze imposed by the U.S. Environmental Protection Agency (EPA) in the 1970s. The downtown parking freeze applies only to "public" spaces, defined as spaces rented for a fee. For each public space added to the parking supply, one must be removed. Spaces that are removed and not replaced are added to a "bank" of spaces that can be allocated to new development. The freeze does not apply to private spaces that are reserved for building tenants, whether or not a fee is charged. The freeze applies only to downtown Boston and does not apply to the South Boston Piers area.

3.3.5 Anticipated Changes to the Transit System

There are a number of improvements to the transit system that the MBTA plans to implement by the project design year 2010.

3.3.5.1 Changes in Fixed Transit Facilities

New fixed services and facilities which the MBTA plans to add to the transit system by the design year are as follows (the present project status is noted parenthetically):

Rapid Transit

- Restoration of Green Line service to Arborway (Design funded)
- Extension of Blue Line platforms to accommodate six-car trains (Construction funded)

Commuter Rail

- Restoration of service on the Middleborough and Plymouth branches of the Old Colony Railroad (Construction funded)

- Extension of the Stoughton Commuter Rail to East Taunton (Design funded)
- Extension of the Franklin Commuter Rail to Milford (Design funded)
- Extension of the Framingham Commuter Rail to Worcester (Preliminary Design funded)
- Extension of the Ipswich Commuter Rail to Newburyport (Design funded)

Express Bus

- South Station Transportation Center improvements including a new indoor bus terminal (Construction funded)
- New North Station Bus Terminal between Canal Street and the Surface Artery (Unfunded)

*Greenbush service now undergoing additional environmental analysis.

A few of these new facilities warrant additional discussion because of their relevance to service to the Piers area. In particular, the Old Colony restoration will probably have the greatest impact on Piers area transit ridership of all the planned improvements. The restoration of service on the Old Colony Lines (which were closed in the 1950s) will improve transit service from the South Shore and is projected to add over 13,000 commuter rail riders per day to South Station by the year 2000. (In Boston, the branches of the Old Colony Line will serve only South Station and will not provide service to Back Bay as do most other South Side commuter rail lines.) The proximity of South Station to the Piers area means that the Old Colony project will improve transit access to the Piers from a large segment of the South Shore.

The two planned bus terminals in downtown Boston will provide both centralized express bus loading areas and facilities from which new services can be based. The South Station Transportation Center bus terminal will consolidate bus services from the Peter Pan, Plymouth and Brockton, and Greyhound terminals into a single indoor bus terminal located in the air rights over the railroad tracks at South Station. New services, such as possible direct service to Logan Airport via the Third Harbor Tunnel, could also be based at South Station. The planned North Station bus terminal will provide expanded space for the MBTA's North Shore and I-93 (North) express bus routes. It could also serve as a base for downtown circulator bus services. Both new bus terminals could be useful in providing service to the Piers area although neither is expected to have substantial excess capacity.

3.3.5.2 Operational Changes in the Transit System

In addition to new capital facilities, there are a number of operational changes expected by the year 2010. These changes focus largely on decreases in headways on the rapid transit system, with some changes in bus routings in order to serve the new North and South Station terminals.

Peak headways for all commuter rail lines are assumed to remain at 30 minutes. Peak headways on rapid transit lines are expected to range from 3 to 8 minutes as follows:

Line:	Origin-Destination:	2010 Headway (in minutes)
Blue	Bowdoin-Wonderland	3.5
Orange	Forest Hills-Oak Grove	4.0
Red	Braintree-Alewife	6.5*
Red	Ashmont-Alewife	6.5*
Red	Mattapan-Ashmont	4.0
Green B	Government Center-Boston College	5.0
Green C	North Station-Cleveland Circle	6.0
Green D	Government Center-Riverside	5.0
Green E	Lechmere-Arborway	6.0
Green E	Lechmere-Brigham Circle	8.0

* 8 minutes in lower growth scenario; 6.5 minutes in high growth scenario.

Source: MBTA Operations Directorate

Bus services in the year 2010 are expected to be the same as those operated in 1987 with certain exceptions regarding downtown terminals. In the year 2000, MBTA routes currently serving Haymarket are assumed to be relocated to North Station, except Routes 400, 426, 440 and 450 which will use the Third Harbor Tunnel/Seaport Access Road to reach the new South Station Terminal. All private carrier express buses currently serving the South Station area, either on the street or in the Peter Pan or Plymouth & Brockton terminals, will be moved inside the new South Station Transportation Center. All private carrier routes currently serving Park Square will be routed to serve the new South Station Transportation Center as well as Park Square.

3.3.6 Anticipated Changes to the Highway System and Parking

Following are committed highway improvements and changes to parking supply anticipated to take place.

3.3.6.1 Changes to the Highway System

The major changes to the roadway system will be brought about by the CA/T Project, as shown conceptually in Figure 3-11. This project involves the depression and widening of the presently elevated Central Artery (I-93) between North Station and the Dewey Square Tunnel, and the construction of a Third Harbor Tunnel (I-90) between South Boston and Logan Airport. The tunnel will be connected to the Massachusetts Turnpike by the Seaport Access Road which crosses industrial South Boston. The Seaport Access Road, shown in Figure 3-12, will include a major interchange in the South Boston Piers area. The roadways connecting the highway ramps to the local street system in the vicinity of Pier 4 are referred to as the East and West Service Roads.

The proposed Seaport Access Road will enable vehicles to travel to the Piers via a limited access highway instead of city arterials and small bridges. In addition, the South Boston Bypass Road to be constructed as part of the CA/T Project will provide commercial vehicles with an exclusive right-of-way from the Southeast Expressway/Massachusetts Avenue interchange to the Piers area. The Massachusetts Highway Department is also constructing a New Northern Avenue bridge across Fort Point Channel connecting to New Northern Avenue, which will extend from the Fort Point Channel to the World Trade Center. The City of Boston is planning to extend Congress Street northeastward across the Commonwealth Flats area of the Piers between B and D Streets to function as a third major arterial. Finally, C Street will extend northward from Summer Street to New Congress Street, and D Street will extend northward to Northern Avenue. Proposed new roadways in the Piers area are shown in Figure 3-13.

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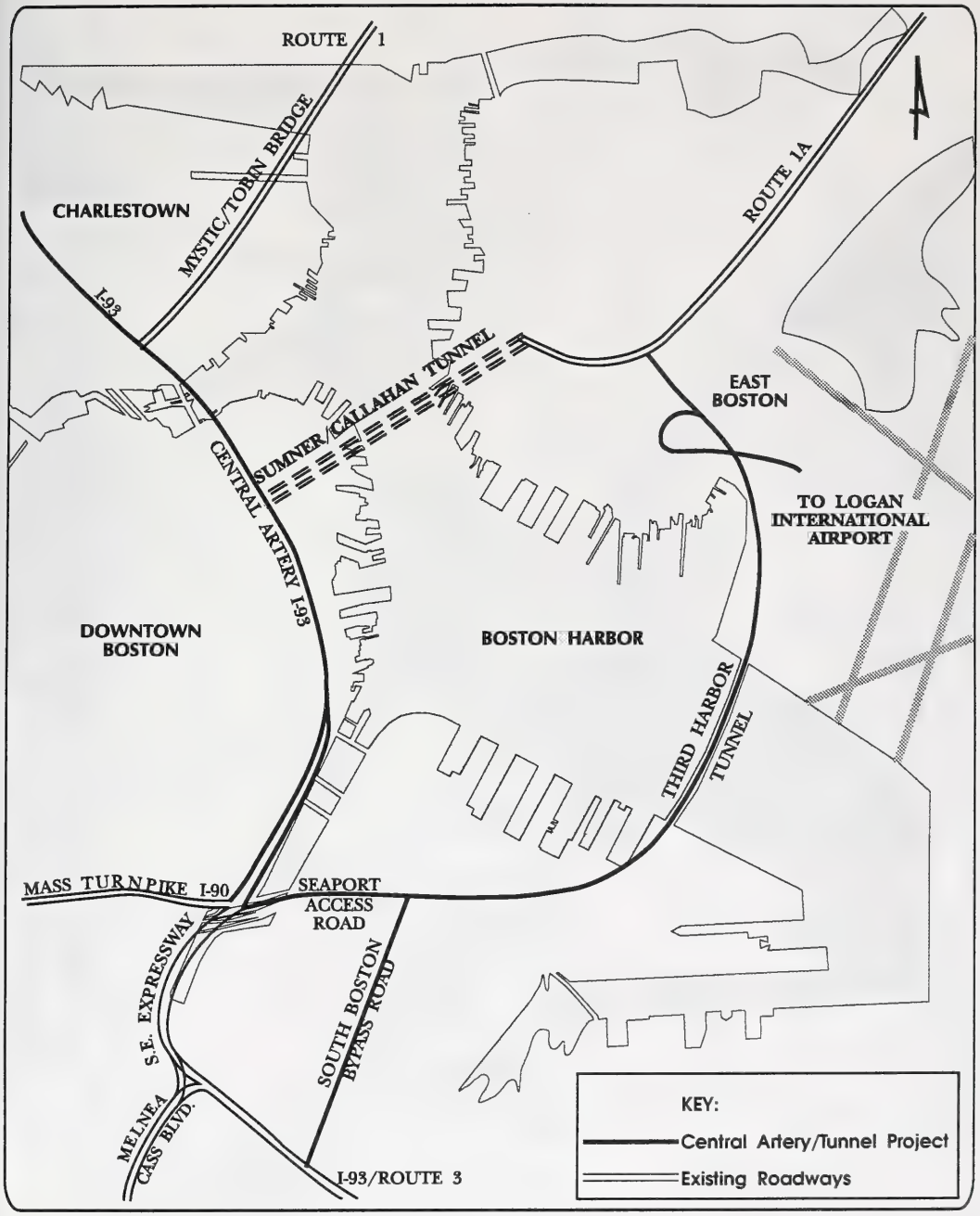
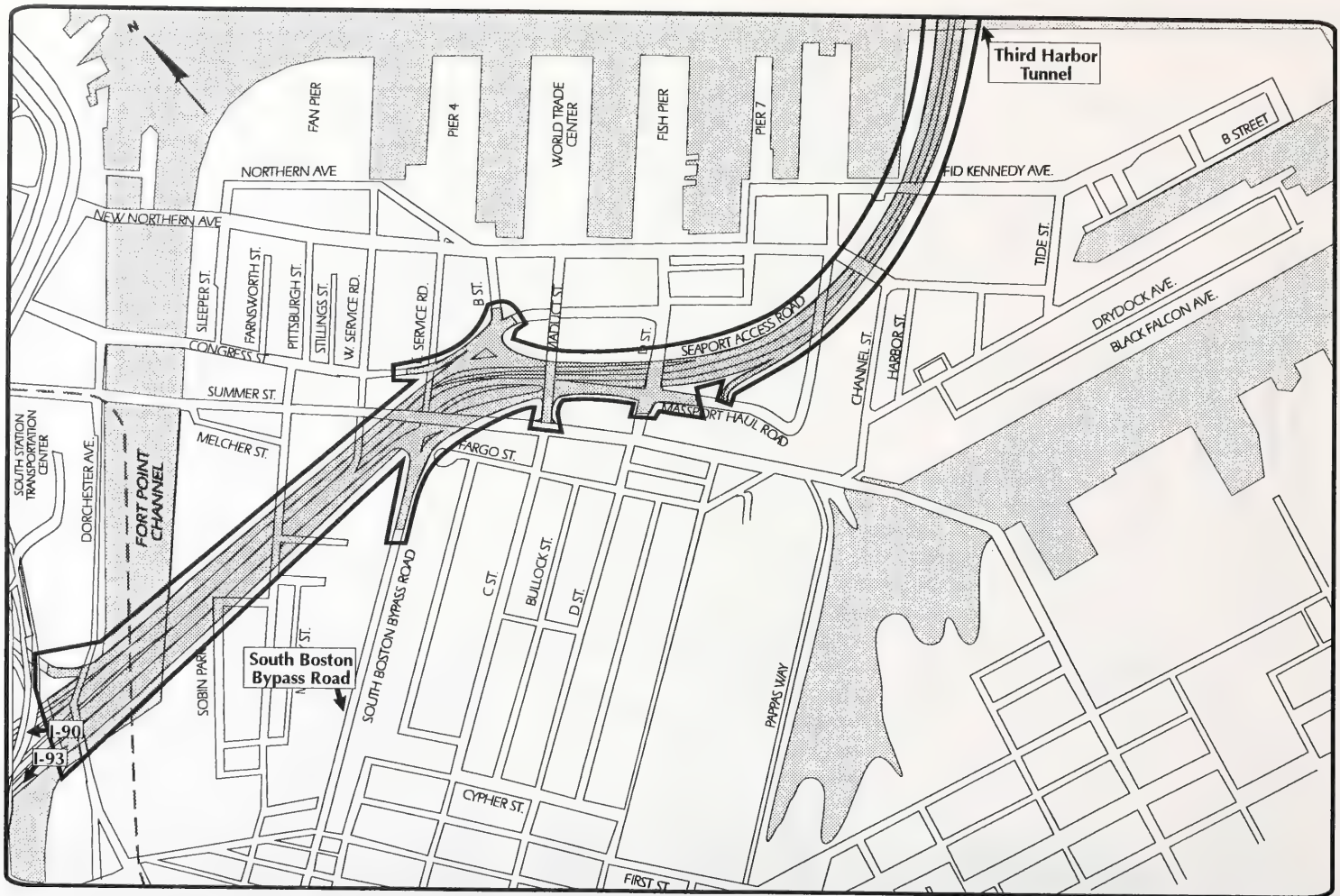
South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-11
Central Artery/Third Harbor Tunnel Project





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South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-12
Seaport Access Road
Alignment In South Boston

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South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-13
Future Roadways

In the absence of any other changes, these improvements would dramatically improve automobile access to and from the Piers area. However, a combination of continued regional economic growth, modernization and growth at Logan Airport to which the Seaport Access Road/Third Harbor Tunnel will provide access from the west and south, and intensive real estate development in the Piers area can all be expected to keep traffic conditions within and on the periphery of the area at congested levels.

3.3.6.2 Changes in Parking Supply

The planned transformation of the South Boston Piers area into a center of office, retail, hotel, residential, and light industrial uses will clearly have a major impact on parking supply and demand. Almost certainly, the current role of the area as a source of inexpensive peripheral parking for downtown will be dramatically reduced or eliminated. Equally as certain, the demand for parking in the area will increase at the same time as the vacant lots are converted to other uses. It is anticipated that if the parking supply and automobile usage are allowed to increase to meet demand, considerable congestion will result on the roadway system, even with the planned highway and street system improvements. Two methods seen as complementary tools to reduce this reliance on the automobile are improved transit services and a constrained supply of commuter parking. The need for improved transit service resulted in this study, while parking restrictions have been addressed separately by the appropriate government agencies.

Over the past few years, officials at both the state and city level have expressed support for a constrained parking policy in the Piers area. Such a policy has been viewed as an important component of transportation strategy and is closely related to plans for improved public transit service. In November of 1990, the Metropolitan Planning Organization (MPO) adopted a parking freeze policy for all of South Boston, recommended that the freeze be incorporated into the State Implementation Plan (SIP) required by the Clean Air Act, and authorized the MPO members to take action to implement the freeze.

The South Boston freeze adopted by the MPO is separate from the downtown Boston parking freeze. The key provisions of the freeze are as follows. South Boston is divided into three zones, as shown previously in Figure 1-7: the residential zone (roughly south of First Street), the industrial/commercial zone (between First and Summer), and the Piers zone. In each zone, the number of off-street non-residential parking spaces is frozen at the existing level plus spaces currently in the environmental approvals process. Within the industrial/commercial and Piers zones, two separate inventories will be created for two types of spaces, the first for state and authority owned spaces and the second for city and privately owned spaces. These two inventories will be administered by the MPO and the City of Boston, respectively. The single inventory in the residential zone will be administered by the city.

From this base inventory for each zone and type, a parking space bank, consisting of an additional 10 percent, is created for each zone for allocation to new developments. At the full opening of the Central Artery/Third Harbor Tunnel, an additional 10 percent allocation will be made to the Piers zone bank for each type. Spaces in the bank can be allocated to new developments by the bank administrators. Spaces permanently removed from use will be placed in the bank. Although spaces may be transferred between types and zones within South Boston by the administrators, no spaces can be transferred into the industrial/commercial or residential zones.

A percentage of the spaces in the Piers zone must be reserved for off-peak use by prohibiting entry between 7:30 and 9:30 a.m. (The spaces may be occupied during these hours but entry will be prohibited.) In the early years of the freeze this restriction will apply to only 10 percent of Piers zone spaces covered by the freeze. After the opening of the transit alternative resulting from this alternatives analysis/EIS process, the number of restricted spaces will be increased to 30 percent.

The South Boston freeze differs from the downtown freeze in that it applies to all non-residential spaces, not just spaces available to the public for a fee. This includes spaces available at no cost to the public and all private employee spaces. Remote parking facilities (for destinations outside South Boston, such as downtown or the airport) are prohibited by the South Boston freeze, although a "grandfather" clause allows the continuation of such existing facilities until such time as the facilities are replaced by new development.

There are currently 8,615 off-street parking spaces in the Piers area. An additional 1,800 spaces planned at the World Trade Center expansion are to be included in the initial freeze inventory. If, as the freeze specifies, 10 percent is added to the bank plus an additional 10 percent added upon opening of the Central Artery/Third Harbor Tunnel, there would be 12,603 off-street spaces permitted in the Piers area. Of these, only 70 percent, or 8,822, would be available for entry between 7:30 and 9:30 a.m. The remaining 3,781 would be open for off-peak users. There would also be an estimated 1,138 on-street spaces (probably metered) available for short term use.

Given constraints on the Piers area parking supply imposed by this freeze that are comparable to current parking constraints in downtown Boston, parking rates in 2010 are assumed to be similar for both areas. In the less densely developed BMIP end of the Piers area, however, rates would be slightly lower than in the eastern end, more resembling parking rates in the East Cambridge business districts, such as Lechmere and Kendall Squares.

3.4 EXISTING AIR QUALITY STANDARDS AND CONDITIONS

3.4.1 Air Quality Standards

Primary and secondary National Ambient Air Quality Standards (NAAQS) have been promulgated by the U.S. Environmental Protection Agency (EPA) as mandated by the Clean Air Act of 1970 ***and Amendments of 1990***. Primary standards are intended to maintain public health with an adequate margin of safety, and are established to protect the most sensitive population groups. Secondary standards have been selected to protect public welfare with regard to matters such as human comfort and enjoyment, vegetation and materials damage, and reduced visibility. Primary and secondary standards are currently in effect for the following air pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), total suspended particulates (TSP), sulfur dioxide (SO_2), and lead. These standards have been adopted by the Commonwealth of Massachusetts and are summarized below:

- **Carbon monoxide**: Primary and secondary standards of 10 milligrams per cubic meter (9 parts per million, ppm) as the maximum 8-hour concentration not to be exceeded more than once per year, and primary and secondary standards of 40 milligrams per cubic meter (35 ppm) as the maximum one-hour concentration not to be exceeded more than once per year.

- **Ozone**: Primary and secondary standards equal to 240 micrograms per cubic meter (0.12 ppm) as a maximum hourly average concentration.

- **Nitrogen dioxide**: Primary and secondary standards of 100 micrograms per cubic meter (0.05 ppm) as an annual arithmetic mean.

- **Total suspended particulates**: Primary standard of 75 micrograms per cubic meter as an annual geometric mean and 260 micrograms per cubic meter as a maximum 24-hour concentration not to be exceeded more than once per year; secondary standard of 150 micrograms per cubic meter as a maximum 24-hour concentration not to be exceeded more than once per year. An annual average concentration of 60 micrograms per cubic meter is used as a guideline to supplement the existing secondary standard.

- **Sulfur oxides (sulfur dioxide)**: Primary standard of 80 micrograms per cubic meter (0.03 ppm) as an annual arithmetic mean and 365 micrograms per cubic meter (0.14 ppm) as a maximum 24-hour concentration not to be exceeded more than once per year; secondary standard of 1,300 micrograms per cubic meter (0.5 ppm) as a maximum 3-hour concentration not to be exceeded more than once per year.

- **Lead**: Primary and secondary standards of 1.5 micrograms per cubic meter as a maximum 3-month concentration.

- **PM10**: Primary and secondary standards of 50 micrograms per cubic meter as an annual arithmetic average and 150 micrograms per cubic meter as a maximum 24-hour concentration with no more than one exceedance expected per year.

3.4.2 Air Quality Conditions and Trends

Air quality conditions throughout the Commonwealth are monitored by the Department of Environmental Protection's (DEP) Division of Air Quality Control. Data are collected on ambient levels of all pollutants for which NAAQS and Massachusetts state standards have been promulgated. Measurements of pollutant levels are recorded via a system of public and private monitoring stations; however, data on ambient concentrations of pollutants commonly associated with transportation sources are generally collected only by the public monitoring stations.

Review of annual monitoring data summary reports for the years ***1988 through 1992***, inclusive, revealed that there were no violations of the state/national standards for lead and nitrogen dioxide during this period at any monitoring station within the Commonwealth. Additionally, there were no violations of the one-hour CO standard or the eight-hour CO standard, although the latter was exceeded ***once in 1991 and 1992 in Worcester at the Central Street site within the Central Massachusetts*** Air Quality Control Region (AQCR). (Note that the eight-hour CO standard can be exceeded but not violated since a violation constitutes two or more exceedances at the same site within a calendar year. ***The last violation of the eight-hour CO standard occurred in Boston in 1986.***)

The most significant air quality problem in the Metropolitan Boston AQCR over the past few years has involved compliance with the air quality standard for ozone. In 1987, there were ***nine days when this standard was exceeded***, including four violations at one site within the Metropolitan Boston AQCR in the town of Sudbury. In 1988, the number of exceedance days rose to 30 with a statewide total of 109 violations, including 24 within the Metropolitan Boston AQCR. A major factor in this dramatic increase was the unusually hot, dry, and sunny weather that prevailed during the summer of that year, the time of year when ozone levels are typically highest. The following year (1989), ***the number of exceedance days of the ozone standard fell to eight***, with violations recorded at seven separate monitoring stations, none of which were located in the Metropolitan Boston AQCR. In 1990, ten violations of the standard were recorded, involving nine of the fifteen DEP monitoring stations. The violations occurred on a total of five separate days during the year. ***In 1991, exceedances were reported at thirteen of sixteen monitoring stations over nine exceedance days. In 1992, the one-hour standard was exceeded at five out of fifteen monitoring stations with four exceedance days. None of these stations are located in the Boston Metropolitan AQCR.***

The EPA has classified Massachusetts as a serious nonattainment area for ozone. The project locale has additionally been classified as a moderate nonattainment area for CO. The Commonwealth has had longstanding difficulties achieving and maintaining the air quality standards for ozone and CO. In the Metropolitan Boston AQCR, this situation has been due in large part to vehicular emissions of CO and the ozone precursors NO_x and HC. Heavy traffic congestion and frequent gridlock on some of the region's principal commuter routes continue to be major factors contributing to exceedances of the air quality standards. Several measures will be implemented to improve this situation, affecting both point and mobile sources of air pollution, some specifically dictated by the Clean Air Act Amendments of 1990, others to be proposed as provisions of the revised State Implementation Plan that is undergoing modification in response to other requirements of the Act.

The pollutants emitted in the largest quantities in motor vehicle exhaust are CO and hydrocarbons (HC) arising from incomplete combustion of fuels. Various oxides of nitrogen (NO_x) are also emitted. Ambient CO concentrations are regulated because they pose a direct health hazard, while HC and NO_x are primarily restricted at present to ensure attainment of the ozone standard, a secondary pollutant formed by chemical reactions of NO_x and HC in sunlight. Usually these reactions occur during the 24-hour period following emission, beyond which dispersion has usually reduced the ambient concentration to low levels. HC and NO_x can also pose a direct health hazard.

Stagnant atmospheric conditions, such as inversions, can prevent dispersion and create an environment favorable to the reactions needed to create ozone. However, even with dispersion, NO_x and HC can contribute to regional haze with impacts on visibility. The reactive nature of NO_x and HC makes predictions of ambient concentrations and assessment of impacts a complex and somewhat uncertain process. For this reason, air quality evaluations for transportation projects usually focus on dispersion modeling of CO using commonly accepted and proven prediction techniques.

Evaluations of total daily or annual emissions of CO, NO_x, and/or HC for the roadway network within an entire region are also used to identify the relative effects of various project alternatives on regional air quality. The results of these analyses are described in detail in Chapter 5, Section 5.5.

3.5 EXISTING NOISE AND VIBRATION STANDARDS AND CONDITIONS

Noise and vibration are inherently linked: all noise is created by some form of vibration. Although noise and vibration have similar physical properties, the analysis of noise and vibration impacts varies significantly. Therefore, noise and vibration will be analyzed separately.

The potential for adverse noise impacts from mass transportation projects is greatest when noise sensitive sites are located in the project area. Noise sensitive sites include residences, motels, hotels, public meeting rooms, auditoriums, schools, churches, libraries, hospitals, parks, and other areas where quiet is desirable or essential. Evaluation of transit alternative noise impacts involves the comparison of current ambient noise levels with forecasted noise levels occurring during transit operation and construction. Noise impacts result from both the operation of the transit alternative as well as associated changes in roadway traffic.

3.5.1 Noise Guidelines and Standards

The most commonly used measure of noise level is the A-weighted sound level on the decibel scale (dBA). The dBA sound level is widely used for transit-related noise measurements and specifications for community noise ordinances and standards.

The dBA has been shown to be highly correlated to human response to noise. FTA criteria state that, as a general rule, an increase of 1 dBA cannot be perceived, a 3 dBA increase is considered barely perceptible, a change of 5 dBA is required before any significant change in community noise level would be perceived, and a 10 dBA increase is heard as approximately a doubling in loudness, independent of the existing noise level.

Environmental noise will fluctuate from moment to moment. Over a period of time there will be quiet moments and peak levels resulting from noisy, identifiable sources (*i.e.*, trucks, aircraft, etc.). It is common practice to condense these noise level fluctuations into a single number, which is the sum of all the noise occurring during the time period. The energy average sound level over a period of interest, L_{eq}, has been widely accepted as a valid measure of community noise. The L_{eq} is equal to the equivalent steady noise level which, in a stated time period, would contain the same energy as the time varying noise during the same time period. The usual period of interest for the L_{eq} is hourly, referred to as the $L_{eq}^{(h)}$. Many surveys show L_{eq} properly predicts annoyance, and this descriptor is commonly used for noise measurement, prediction, and impact assessment. An additional noise description used in transportation studies is the single event maximum noise level of L_{max}. The L_{max} measures the maximum noise level for a single event and is useful in describing maximum noise exposure.

Noise criteria have been developed by government agencies for the various modes of mass transit. For this impact assessment, Federal Highway Administration (FHWA) criteria are used in assessing roadway noise. Additional evaluation and impact assessment criteria comply with FTA's draft *Guidance Manual for Transit Noise and Vibration Impact Assessment*. Application of these criteria is dependent upon the land use category of the impacted property. For example, criteria are more stringent for residential properties than for lively commercial areas.

3.5.1.1 FHWA Regulations for Traffic-Generated Noise-Hourly Noise Levels [$L_{eq}^{(h)}$]

The FHWA has established maximum acceptable noise levels for various land use categories. These regulations, entitled "Procedures for Abatement of Highway Traffic Noise and Construction Noise," are contained in Title 23 CFR Part 772. The noise criteria represent the upper limit of acceptable traffic-generated noise emissions and are used to assess the degree of noise impact on human activities. Noise-sensitive land uses/receptors in the vicinity of roadway projects must be identified, and future design year noise levels must be predicted for the noise-sensitive receptors. The regulations specify Noise Abatement Criteria (NAC) considered by FHWA to be the upper limits of acceptable exterior and interior noise. These limits are shown in Table 3-11.

TABLE 3-11: FHWA NOISE ABATEMENT CRITERIA (NAC)/ACTIVITY RELATIONSHIPS

Activity Category	Noise Abatement Criteria (dBA) $L_{eq}^{(h)}$*	Description of Activity Category
A	57 (Exterior)	Tracts of land where serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Such areas could include amphitheaters, particular parks or portions of parks, open spaces, or historic districts dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, and parks not included in category A and residences, motels, hotels public meeting rooms, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in categories A and B above.
D	—	Undeveloped land requirements to be established in cooperation with local officials.
E	52 (Interior)	Residences, motels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

* $L_{eq}^{(h)}$ is the value of L_{eq} for a 1-hour period.

Source: Federal Highway Administration, Title 23 CFR Part 772.

Predicted design year noise levels are compared with the appropriate NAC to determine the impact of noise attributable to the project. An exterior NAC of 67 dBA (L_{eq}) is most commonly used because many sensitive receptors have some form of associated outside activities. FHWA also states that a noise impact will occur if the predicted traffic noise level substantially exceeds the existing noise level, even if the predicted noise level is less than the NAC. FHWA categorizes impacts as follows when existing noise levels are exceeded: less than five dB, no impact; 6-10 dB, minor impact; 11-15 dB, moderate impact; greater than 16 dB, substantial impact.

3.5.1.2 City of Boston Construction Noise Regulations

Noise impacts from project construction activity will be evaluated using FHWA criteria. Project construction will also need to comply with the City of Boston Code, Ordinance 7, Chapter 3, Section 50, the Air Pollution Control Commission (APCC) of the Environment Department (City of Boston APCC, 1977), which limits L_{10} (the hourly noise level exceeded 10 percent of the time) and maximum noise levels, L_{max}, from construction activity. These noise levels are measured at the property line of different land uses, but not closer than 50 feet from any active construction.

According to the city noise regulations, building construction is limited to the hours of 7:00 a.m. to 6:00 p.m. on weekdays unless an emergency situation exists or unless a permit is granted to work at other times. In general, no construction device can be operated which generates noise levels greater than 86 dBA at a distance of 50 feet from the device. This standard is not applicable to impact devices. For the L_{10} category, the limits are 75 dBA for residential or institutional areas, 80 dBA for business or recreational sites, and 85 dBA for industrial settings.

3.5.1.3 FTA Noise Criteria

The noise impact criteria in Table 3-12 apply to all rail projects (*e.g.*, rail rapid transit, light rail transit, commuter rail, and automated guideway transit) as well as fixed facilities such as storage and maintenance yards, passenger stations and terminals, parking facilities, and substations. They are to be used also for separate roadways that are built exclusively for buses and HOVs. However, for busways and HOV lanes that are to be integrated into existing highways (*e.g.*, the addition of new lanes or the redesignation of existing lanes on a highway), the FHWA's noise abatement criteria are the appropriate criteria.

The criteria are defined by two categories — *Impact* and *Severe Impact* — which identify threshold project noise levels as a function of increasing ambient noise, up to a point at which impact is based solely on project noise. The lower bound for the *Impact* category stops at 66 dB, which reflects the standard limit for an acceptable living environment defined by a number of federal agencies. The *Severe Impact* category has an upper bound of 75 dB, a level associated with an unacceptable living environment.

3.5.1.4 Existing Ambient Noise Levels

Comparison of existing noise levels with projected noise levels is a baseline for assessing the degree that project alternatives would impact sensitive receptors. Therefore, existing ambient noise levels must be determined as a first step in the assessment process.

Measurement sites were chosen to be representative of all noise-sensitive receptors within several hundred feet of the alternative service routes and alignments. The chosen noise sensitive receptor sites are shown in Figure 3-14 and described in Table 3-13. The measured noise levels at these sensitive receptor sites are also shown in Table 3-13; noise level measurements were taken at these sites in 1988. Hourly L_{eq}s in dBA are tabulated for all twelve sensitive receptors.

3.5.2 Vibration Guidelines and Standards

Impact criteria for ground vibration have been established by the National Academy of Sciences, Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) and are used in this assessment. The assessment of impact is based on the potential for: (1) major structural damage; (2) minor architectural damage; and (3) annoyance. Annoyance to people in buildings is differentiated by building use.

TABLE 3-12: NOISE LEVELS DEFINING IMPACT FOR TRANSIT PROJECTS

Existing Ambient Noise Level L_{eq} or L_{dn}	Project Noise Impact Levels L_{eq} or L_{dn} (dBA)*		
	No Impact	Impact	Severe Impact
<45	<52	52-58	>58
45	<52	52-58	>58
46	<53	53-59	>59
47	<53	53-59	>59
48	<53	53-59	>59
49	<54	54-59	>59
50	<54	54-59	>59
51	<54	54-60	>60
52	<55	55-60	>60
53	<55	55-60	>60
54	<55	55-61	>61
55	<56	56-61	>61
56	<56	56-62	>62
57	<57	57-62	>62
58	<57	57-62	>62
59	<58	58-63	>63
60	<58	58-63	>63
61	<59	59-64	>64
62	<59	59-64	>64
63	<60	60-65	>65
64	<61	61-65	>65
65	<61	61-66	>66
66	<62	62-67	>67
67	<63	63-67	>67
68	<63	63-68	>68
69	<64	64-69	>69
70	<65	65-69	>69
71	<66	66-70	>70
72	<66	66-71	>71
73	<66	66-71	>71
74	<66	66-72	>72
75	<66	66-73	>73
76	<66	66-74	>74
77	<66	66-74	>74
78	<66	66-75	>75
79	<66	66-75	>75
80	<66	66-75	>75
>80	<66	66-75	>75

* L_{eq} is used in situations involving only daytime land use and is well suited to represent noise exposure for time periods with considerable transit activity. L_{dn} (day/night average) is used in situations where night time sensitivity is a factor.

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Fig. 3-14
Noise Sensitive Receptor Sites

SITE NO.	SITE DESIGNATION
1	St. Anthony's Shrine, Monastery and Chapel
2	Hong Lok Subsidized Housing
3	St. James R. C. Church
4	Tufts N. E. Medical Center
5	Chauncy House
6	Wang Center for Performing Arts
7	Tai Tung Village
8	Oak Street Annex
9	Childrens Museum
10	Sleeper St. Residential Buildings
11	Our Lady of Good Voyage Chapel
12	Statler Park

TABLE 3-13: NOISE SENSITIVE RECEPTOR SITES DESCRIPTION AND MEASURED AMBIENT NOISE LEVELS

Site No.	Site Designation	Site Location	Site Land Use	Receptor Site	Ambient Noise Level Hourly L_{eq} (DBA)
1	St. Anthony's Shrine, Monastery and Chapel	100 Arch Street north of Summer Street	Church	Facade of building closest to project roadway	62
2	Hong Lok Subsidized Housing	Essex St. west of Washington	Residential	Facade of building closest to project roadway	65
3	St. James R.C. Church	249 Harrison Avenue	Church	Facade of church closest to project roadway	64
4	Tufts New England Medical Center	South of Kneeland St. near Harrison Ave.	Educational	East side of building at Kneeland St.	67
5	Chauncy House	Chauncy St. at Essex St.	Residential	Entrance of building facing Chauncy St.	64
6	Wang Center for Performing Arts	268 Tremont St.	Music Hall	Facade of building facing Tremont St.	70
7	Tai Tung Village	Harrison Ave. south of Oak St.	Residential/ Commercial	Center of mall area east of Harrison Ave.	49
8	Oak Street Annex	Oak St. west of Harrison Ave.	Educational	Facade of building nearest intersection Oak St./Harrison Ave.	57
9	Children's Museum	Museum Wharf/Congress St. near Sleeper St.	Museum	Museum Wharf	59
10	Sleeper Street Residential Buildings	15-37 Sleeper St.	Residential	Facade of 29 Sleeper St. closest to project roadway	62
11	Our Lady of Good Voyage Chapel	65 Northern Ave.	Church	Facade of church closest to project roadway	62
12	Statler Park	Near intersection of Stuart/Columbus/ Arlington Sts.	Park	South area of park closest to project roadway	66

3.5.2.1 Criteria For Structural Damage to Buildings

If exposed to sufficiently high levels of ground vibration, a building may suffer structural damage, such as glass breakage or cracking plaster. Low levels of ground vibration may cause minor damage, such as fine plaster cracks. Ground vibrations with peak velocities of 7.6 inches/second (in/sec) may cause major damage in residential structures, while peak velocities near 5.4 in/sec may cause minor damage (U.S. Bureau of Mines, 1971). The International Organization for Standardization (ISO) standard (ISO/TC108/SC2/WG3) for structural damage states that a peak velocity of 2.0 in/sec should not be exceeded if the probability of structural damage to buildings is to be small (less than 5 percent). CHABA also suggests a limit of 2.0 in/sec peak velocity as safe with respect to structural damage. This peak velocity figure will be used as the structural damage criterion for the project assessment.

3.5.2.2 Criteria for Architectural Damage to Buildings

Minor damage to buildings may result for various reasons, including expansion and contraction of building materials due to changes in temperature and humidity, freeze/thaw cycles during the winter months, differential settlement of foundations, and the natural deterioration of building materials. Any of these elements may affect a building's architectural elements and may cause minor damage. These naturally occurring effects may increase due to traffic-generated vibration. A reassessment of the U.S. Bureau of Mines vibration data has determined that the threshold of architectural damage to buildings occurs at a peak velocity of 0.2 in/sec (Jackson, 1967). This figure will be used in this assessment as a safe limit of vibration that would not cause architectural damage to buildings. This level is probably safe and accurate in terms of architectural damage for historical buildings; however, long-term fatigue damage may occur after many years of vibration. A peak ground vibration velocity of 0.08 in/sec is suggested as a more conservative criterion for architectural damage to be applied to historical buildings (German Standards Institute, 1970).

3.5.2.3 Criteria for Annoyance

Vibrations caused by the operation of transit systems and construction equipment may cause annoyance to people living in the vicinity, if these vibrations are perceptible. The degree to which people may be annoyed is dependent on the intensity of the vibrations and the land use involved.

Vibration may be generated in buildings by groundborne noise and vibration. The vibration of buildings caused by external sources, such as transit operations, may result in audible noise referred to as groundborne noise. Groundborne noise and vibration are caused by wheels rolling on rails or pavement, causing movement within the transit structure or roadway which radiates vibration into the soil from where it can propagate to nearby buildings. Occupants of an affected building perceive vibration in two ways: (1) as a mechanical motion or (2) as vibration of building components radiating audible airborne sound, identified as a low-frequency rumble. The latter perception is more common than the former. Experience with groundborne vibration indicates that when building vibration is perceptible, people worry about damage to their structures.

Although vibration levels may be well below the level that would cause structural or architectural damage, vibrations resulting from transit operations or construction equipment can result in annoyance if such vibrations are perceptible to people living or working in the area. The threshold for vibration perception is used as the basis of annoyance vibration impacts. Table 3-14 shows criteria for annoyance by land use.

3.6 EXISTING ECOSYSTEMS STANDARDS AND CONDITIONS

Ecosystems refer to the water resources, marine life, upland vegetative communities, and wildlife habitats of an area. The ecosystems of the project area consist primarily of the coastal/water resources associated with the Fort Point Channel. The urban character of the project area severely limits the extent of upland vegetation and, hence, wildlife habitat.

3.6.1 Federally Regulated Wetlands and Waterways

Figures 3-15 and 3-16 indicate the project areas that are subject to federal and state regulations and/or policies. Specifically, only the Fort Point Channel and associated floodplain areas are subject to jurisdiction under federal wetlands and waterways regulations.

TABLE 3-14: ACCEPTABLE CRITERIA FOR ANNOYANCE DUE TO GROUNDBORNE VIBRATION

Building Use Category	Maximum Peak Vibration Velocity (in/sec)	Comments
Hospital and Critical Areas	0.005	
Residential (nighttime)	0.007	
Residential (daytime)	0.010	Criterion also applies to churches, schools, hotels, and theaters
Office	0.020	Criterion applies to commercial establishments
Factory	0.040	Criterion applies to industrial establishments

Source: Committee on Hearing, Bioacoustics, and Biomechanics (CHABA).

U.S. Army Corps of Engineers (ACOE) regulation over waterways of the United States stems primarily from Section 404 of the Federal Water Pollution Control Act and Section 10 of the Rivers and Harbors Act of 1899. Section 404 governs the placement of dredged or fill material in waters of the United States. Section 10 regulates the placement of structures in navigable waters. Waters of the United States include wetlands, defined as those areas that are inundated or saturated by surface or groundwater at a frequency and duration to support, and that, under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, bogs, marshes, and similar areas in fresh or salt water. Given this definition, no wetlands are present in the project area. ***In 1981, the ACOE Harbor Improvement Project from the mouth of the Fort Point Channel to the Dorchester Avenue bridge was legislatively abandoned as a condition of the approval of the New Northern Avenue bridge (Public Law 97-128 [§ 1493]; December 29, 1981); this abandonment removes many design limitations and eases the federal permitting review process relative to navigation.***

3.6.2 State Regulated Wetlands and Waterways

In Massachusetts, wetlands are protected by the Wetlands Protection Act (MA WPA; MGL Chapter 131 Section 40) and associated regulations (310 CMR 10.00 et seq.) which are administered by local conservation commissions and the DEP Division of Wetlands. Generally, wetlands are defined as either fresh water or coastal environments, the latter including, but not limited to, banks, saltwater marshes, beaches, dunes, tidal flats, land under the ocean, estuaries, salt ponds, land subject to tidal action or 100-year storm flowage, certain waters that are anadromous/catadromous fish runs, land containing shellfish,

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Fig. 3-15
Coastal Zone & Chapter 91 Jurisdiction (Approximate)

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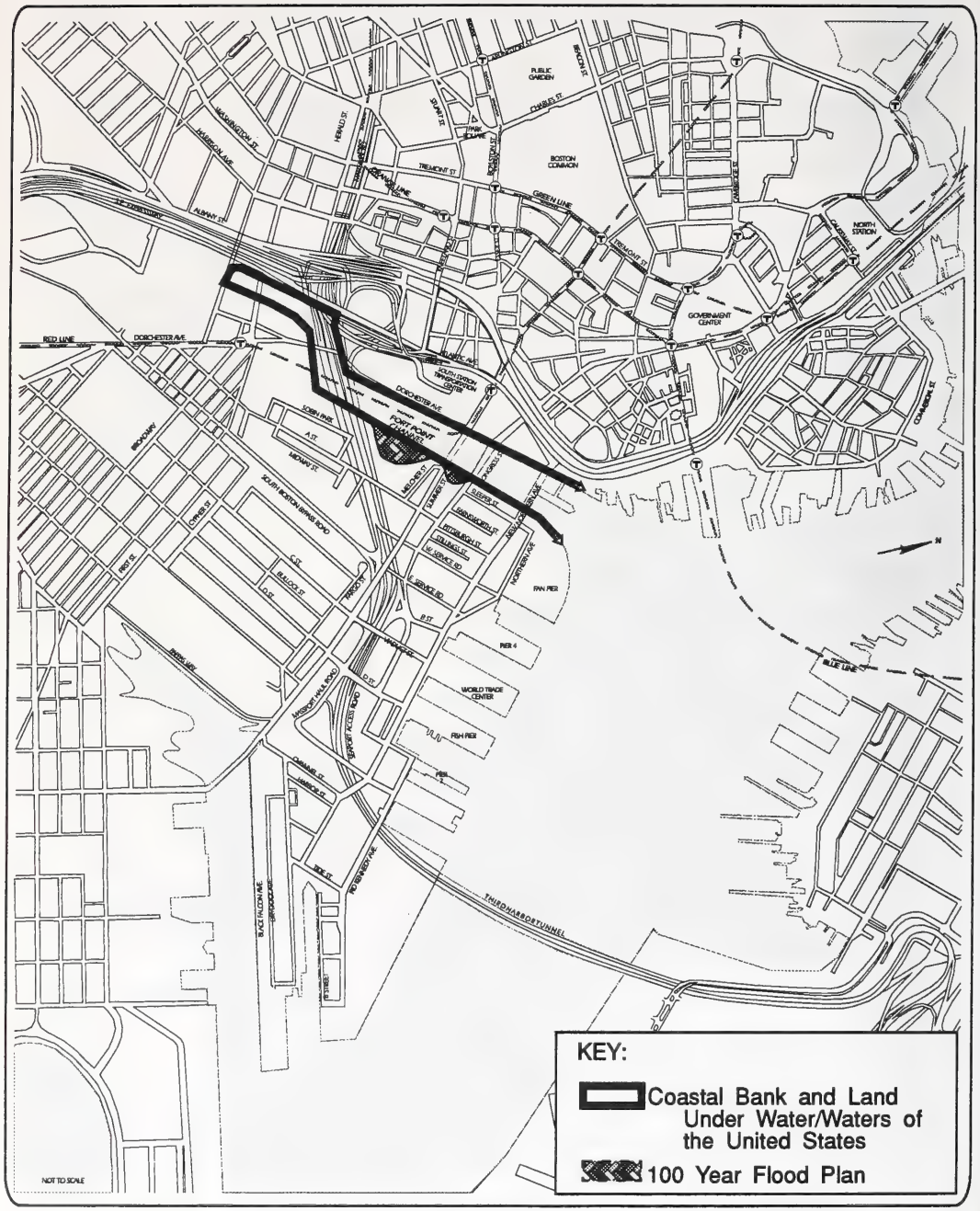
Fig. 3-16
Detail of Fort Point Channel Water Resources



and designated port areas. Under the Act, these resource areas have presumed significant values that include, but are not limited to, one or more of the following interests: protection of marine fishery and shellfish resources; storm damage prevention; flood control; prevention of pollution; and protection of wildlife habitat.

As defined above, the Fort Point Channel and portions of the land immediately adjacent to the channel would be defined as wetlands. Specifically, these areas or portions thereof would be listed as including, at a minimum, Land Under the Ocean, Coastal Banks, and Lands Subject to Coastal Storm Flowage. The extent of the area defined as wetlands beyond the Wetlands Protection Act includes the entire channel and those areas beyond its banks designated as lying within the 100-year floodplain shown previously in Figure 3-16.

In addition to wetlands, tidelands of the state are protected under Chapter 91 of the Massachusetts General Laws. Tidelands are defined in the Chapter 91 regulations (310 CMR 9.00) to include "all lands and waters lying between the high mark and the seaward limit of the Commonwealth's jurisdiction." Within Section One of the statute, this definition is currently expanded to include "all present and former submerged lands and tidal flats lying below mean high water." The placement and use of fill and structures within the limits of flowed (existing) or filled (historic) tidelands require a Chapter 91 license.

As currently exists, the Fort Point Channel is entirely within Chapter 91 bounds. Historically, however, much of Boston and South Boston has been developed over former tidelands. As such, a large portion of the project area lies within the jurisdictional boundaries of Chapter 91. Key issues associated with a Chapter 91 license are the protection of public rights to the waterfront, the revitalization of the waterfront, the protection of the biological and cultural environment, and the use of sound engineering practices.

The Executive Office of Environmental Affairs (EOEA) Office of Coastal Zone Management (CZM) oversees the regulation of the Massachusetts Coastal Zone Management Program (301 CMR 20.00 et seq.). All projects requiring a federal license and occurring within the coastal zone must obtain a Consistency Certification from CZM. Additionally, Chapter 91 and Water Quality Certification require compliance with CZM policies.

The Massachusetts DEP Division of Water Pollution Control oversees the regulation of Water Quality Certification (WQC) pursuant to 314 CMR 9.00 et seq. These regulations establish procedures and standards governing dredging and dredge material disposal projects in waters of the Commonwealth. All projects that require a federal license or permit require a WQC permit as a result of delegation of authority under Section 401 of the Federal Water Pollution Control Act. Additionally, projects involving discharges to the waters of the Commonwealth, or requiring a Chapter 91 license, will also need a WQC permit. Additional details on Chapter 91 licensing are provided in Chapter 5, Section 5.7.

3.6.3 Upland Vegetation and Wildlife Habitat

The project area is highly urbanized, with little open space and/or unpaved land. Hence, existing vegetative communities are limited in the area, widely scattered, and of low species diversity. Within the current project area, the portion west of the Fort Point Channel only supports vegetation on Avenue de Lafayette, where ginkgo trees (Ginkgo biloba) have been planted along the street. In the corridor east of the Fort Point Channel, urban successional species have established in vacant lots and parking areas, such as the proposed corridor for New Northern Avenue and the Massport parking lot. Typical species include ragweed, Queen Anne's lace, sweet white clover, tansy, chicory, evening primrose, and trembling aspen. This general lack of vegetation reduces the corridor's value for wildlife habitat, although typical urban species are present. The Fort Point Channel itself offers habitat, primarily to waterfowl such as cormorants. The occurrence of any endangered or threatened species in the project area is highly unlikely.

3.6.4 Marine Life

The water and sediment quality of the Fort Point Channel is degraded to various degrees. As a result, marine life within the channel tends to be limited to species having a relatively high pollution tolerance.

This is especially true of the macrobenthos, such as worms and shellfish, which are relatively immobile. Finfish and marine mammals may occur as transient migrants within the channel; however, for the most part, these species are not permanent residents.

A comprehensive list of marine macrobenthos species inhabiting the Boston Inner Harbor was developed for the CA/T Project from existing data and a project-specific field sampling program. This list indicates that over ninety species of macrobenthos have been observed in the Inner Harbor, including Cnidaria (jellyfish and anemones), Nematoda (roundworms), Annelida (segmented worms), Arthropoda (shrimps and crabs), Mollusca (clams and snails), and Ectroprocta (bryozoans).

Over forty-four species of finfish have been observed in, or taken from, the waters of the Boston Inner and Outer Harbors. These include sport and commercial fishes such as herring, smelt, codfish, hakes, seabasses, mackerel, and flounder. Dogfish, skate, and eels are also common in these waters. Atlantic Cod and Winter Flounder are noted sportfish within Boston Harbor, with the latter representing one of the most common permanent inhabitants of the Boston Inner Harbor. Currently, the spring spawning of the Winter Flounder in the harbor is protected by a moratorium on harbor dredging between February 1 and May 15. State wetland regulations prohibit dredging in anadromous fish runs between March 15 and June 15.

The mobility of the marine mammals of the Massachusetts coastline results in the potentiality of any of these creatures entering Boston Harbor. However, the occurrence of any marine mammals in the Fort Point Channel should be considered an uncommon if not highly unlikely event, although Harbor Seals and Harbor Porpoises may be observed on rare occasions within the channel. The likelihood of any threatened or endangered species occurring in the Fort Point Channel is extremely low.

3.6.5 Rodent Control

Rodents, in particular the brown rat (Rattus norwegicus), have been a major problem in New England urban areas since early colonial times and are present throughout the project area. Rats are common carriers of diseases and can also cause severe property damage. They can survive in a wide range of habitats, but are particularly associated with sewer systems. The availability of food and the insulated nature of combined storm and sanitary sewers provide a particularly safe environment for breeding, as well as protection from predation by man or other animals. Rats are rapid breeders; a female rat can produce a litter every three weeks. This rapid repopulation of rats is the principal cause of failure of rat control programs utilizing poisons for only a limited time period.

One of the major environmental concerns associated with large-scale construction projects in urban areas is rodent infestation in areas or neighborhoods adjacent to construction due to rat habitat destruction. In order to control rat migrations during such projects, extermination within the construction work area has been used in the past. The *Standard Specifications of the Massachusetts Bay Transportation Authority* (MBTA, 1991) will be used to develop construction specifications for rodent control.

The general approach outlined in the MBTA specifications consists of poisoning areas with the use of a toxicant (i.e., zinc phosphide) combined with a suitable bait. In a phase referred to as the "blitz," the treated bait is placed in structures that will be razed and in adjacent areas in order to attract the largest possible number of rodents. Carcasses are removed daily. Following initial applications, baiting is continued to prevent rodent migration.

3.7 EXISTING WATER RESOURCES AND STANDARDS

The Fort Point Channel is an urban waterway to which access is limited and whose water and sediment quality has been degraded by local discharges of combined sewer overflows (CSOs) and urban runoff. At the same time, it is a source of process water for several businesses and serves as an accessway to several of those businesses. It is also a part of Boston Harbor's natural ecosystem and a visual and historic link to the harbor.

3.7.1 Regulations

A National Pollution Discharge Elimination System (NPDES) permit would be required for the discharge of runoff from construction areas and of groundwater from excavations to existing surface waters during the construction phase of the project. In addition, and more specifically as a condition of the NPDES regulations, a Notice of Intent under the Massachusetts Wetlands Protection Act would need to be submitted to the Boston Conservation Commission which describes the character and impact of the proposed construction-related discharges.

The NPDES permit would likely include limitations on the discharge of specific constituents such as suspended solids, volatile organic compounds (VOCs), and total petroleum hydrocarbons (TPHs). In order to comply with the requirements of the permit, construction contractors would be required to implement standard procedures to limit the suspended sediment content of the construction area runoff. These procedures would include the use of hay bales and/or temporary sedimentation basins. Removal of organic compounds and/or oil and grease may also be required.

Contractors would also be required to develop and submit plans which outline best management practices to be followed in the handling of fuels, equipment maintenance supplies, and construction materials in the construction area. Specific sub-areas would be designated for fuel handling, fuel storage, and maintenance of equipment. In addition, monitoring and contingency plans would be required to address the possibility of spills and leaks within the construction zones. Compliance with any additional requirements specified by the Boston Conservation Commission would also be required.

Construction area runoff from the maintenance facility area would also be subject to NPDES jurisdiction. Such a permit would include conditions as described above. In addition, once constructed and operational, the maintenance facility would be classified under EPA Stormwater Regulations as a facility engaging in "industrial activity" (40 CFR Part 122.26); it would therefore require a post-construction NPDES permit for stormwater discharges. The two types of NPDES stormwater discharge permits most applicable to this type of facility are a general permit and an individual permit. A general permit is considered most appropriate for this type of facility. According to the draft regulations for general permits, the application process involves completion and filing of a Notice of Intent with EPA Region I requesting general permit status. Once approved by EPA, the conditions of the permit would require preparation of a stormwater pollution prevention plan which typically includes a description of potential pollutant sources, stormwater management controls, and an annual site inspection by appropriate personnel and possibly wet weather sampling.

Finally, as in the case of the construction-related NPDES permit described above, a Notice of Intent under the Massachusetts Wetlands Protection Act would need to be filed with the Boston Conservation Commission.

3.7.2 Physical and Hydrologic Characteristics

The Fort Point Channel is the remnant portion of the Boston Inner Harbor formally known as, at its mouth, the South Boston Flats and, at its head, South Cove. The channel is approximately 5,600 feet long from its mouth at the Boston Inner Harbor immediately north of the Northern Avenue bridge to its head at the Fourth Street bridge. Its width tapers from 560 feet at the Northern Avenue bridge to less than 200 feet between the Broadway and Fourth Street bridges.

The banks of the channel are composed entirely of vertical cut stone bulkheads, with the exception of some limited stretches in the former South Cove area. Specifically, the western bank between the Broadway and Fourth Street bridges and the eastern bank between the Dorchester Avenue and Railroad bridges consist of steeply sloping cut stone and graded soil.

The mean tidal range within the channel is 9.5 feet, while the mean spring tidal range is 11.0 feet. At mean low water the bottom is exposed in a few limited areas along the banks, principally in the southern end of

the channel. For the most part, however, mean low water depths vary from several feet in the South Cove area to greater than 25 feet at the mouth of the channel.

A complete tidal flushing or exchange of water within the Fort Point Channel was determined to take approximately 2.1 complete tidal cycles, or 27.3 hours. The volume of water represented by the difference between high and low tide (the tidal prism) was determined to be 21.5 million cubic feet, and a mean low water volume of 24.1 million cubic feet was indicated.

The Fort Point Channel mouth has approximately 26 times the cross-sectional area necessary to transmit the given prism within the existing tidal time frame. Constricting the channel to half its cross-sectional area would still leave it 13 times the necessary size for flushing. Such constriction near the mouth of the channel would increase the percentage of the total channel volume represented by the tidal prism which would decrease the flushing time, although probably not to any noticeable extent.

The low tidal current velocities measured at the mouth of the Fort Point Channel reflect the large size of the channel mouth relative to the volume of water within the channel. Should the channel's mouth be constricted to half its width, no scouring of the channel bottom and resuspension of bottom sediments is expected. This conclusion is supported by the fact that the sediments of the Fort Point Channel bottom consist of relatively cohesive mucks with a texture of silty ooze which have a relatively high threshold velocity. Furthermore, the underlying Boston Blue Clay is highly consolidated and could be expected to have a threshold velocity in the uppermost range for silt and clays.

3.7.3 Water Quality

The water quality within the Boston Inner Harbor, including the Fort Point Channel, has been upgraded from class SC to class SB under the Massachusetts DEP Division of Water Pollution Surface Water Quality Standards regulations 314 CMR 4.00 (July 20, 1990). Waters assigned SB classification are designated as habitat for fish, other aquatic life and wildlife, and for primary and secondary contact recreation. Criteria for SB waters include a minimum dissolved oxygen level of 5.0 mg/l, a pH in the range of 6.5 to 8.5 units, and a fecal coliform bacteria not exceeding 400 MPN per 100 ml.

Existing water quality information relative to conditions within the Fort Point Channel includes data from a variety of sampling programs associated with proposed dredging and filling programs within the Boston Inner Harbor. Data from three such programs were compiled for the CA/T Project. These data, which are summarized in Table 3-15, clearly demonstrate the high degree of variability in water quality within the harbor.

As the table shows, the waters of the Boston Inner Harbor do not consistently meet the criteria of the SB classification currently assigned to this body of water. In particular, the data indicate that dissolved oxygen levels are often well below the 5.0 mg/l minimum levels. Indeed, samples taken at the bottom, middle, and top of the water column at the mouth of the Fort Point Channel all had dissolved oxygen levels less than 5.0 mg/l.

The data also indicate that the water quality in the Boston Inner Harbor varies considerably. While the reason for this wide variation in water quality is not readily apparent, the higher values may represent the impact of primary treatment plant discharges from Deer Island and Nut Island, in addition to the large number of CSOs discharging to the harbor during storm conditions.

TABLE 3-15: RANGE OF WATER QUALITY - BOSTON INNER HARBOR

Parameter	Maximum (mg/l)	Minimum (mg/l)
pH	8.0	7.6
Suspended solids	169.0	.34
Oil and grease	2.6	0.0
Total Kjedahl nitrogen	2.4	0.64
Ammonia nitrogen	0.19	0.01
Sulfate	3,325	1,950
Total phosphorous	0.10	0.02
Conductivity (µmhos/cm)	40,000	34,000
Dissolved oxygen	>9.5	3.4
Total coliform (# organisms/100 ml)	2,400	230
Fecal coliform (# organisms/100 ml)	380	20
Chloride	14,000	11,000
Arsenic	<0.001	<0.001
Cadmium	0.014	0.0005
Chromium	0.004	<0.004
Copper	0.01	0.0014
Lead	0.017	0.002
Mercury (µg/l)	0.05	0.005
Nickel	0.02	0.004
Silver	<0.08	<0.08
Vanadium	<0.04	<0.04
Zinc	0.145	0.002
Polychlorinated biphenyls (PCBs) (µg/l)	1.0	0.05

Source: Artery/Tunnel DEIS, 1982.
mg/l = milligrams/liter
µg/l = micrograms/liter

3.7.4 Navigation Within the Fort Point Channel

The Fort Point Channel is approximately 5,600 feet long, and tapers in width from 560 feet at its mouth to under 200 feet at its headwaters. Five bridges essentially divide the channel into five basins. The first of these basins extends from the Boston Harbor to the Northern Avenue bridge; the second from the Northern Avenue bridge to the Congress Street bridge; the third from the Congress Street bridge to the Summer Street bridge; the fourth from the Summer Street bridge to the Dorchester Avenue bridge; and the fifth from the Dorchester Avenue/Penn Central railroad bridge to the West Fourth Street bridge. Although a sixth bridge crosses the latter basin, its clearance is sufficiently greater than any of the other bridges as to essentially not further divide this last basin. Currently a seventh bridge, the New Northern Avenue bridge, is under construction in the basin between the old Northern Avenue and Congress Street bridges.

An ACOE Harbor Improvement Project, adopted in 1825 and supplemented in 1962, specified a dredged channel 23 feet deep and 175 feet wide at or near the center of the Fort Point Channel from the Boston Inner Harbor to the Dorchester Avenue bridge. This project was completed to the Summer Street bridge in 1966, while the project between the Summer Street bridge and the

Dorchester Avenue bridge was abandoned. In 1981, the entire federal project in the Fort Point Channel was legislatively abandoned as a condition of the approval of the fixed span New Northern Avenue bridge (Public Law 97-128 [§ 1493]; December 29, 1981]. This legislative abandonment removes many design limitations on construction within the channel, and eases the federal permitting review process relative to navigation. The 1987 edition of the Coast Pilot (Volume I) published by the National Oceanic and Atmospheric Administration (NOAA) notes that the controlling depth (mean low water) was 11 feet at the Northern Avenue and Summer Street bridges in 1978, and 21 feet to the Dorchester Avenue bridge as of 1959. These depths are also reflected on the November 1984 NOAA Nautical Chart for the Boston Inner Harbor.

3.7.4.1 Navigational Constraints

Constraints to navigation into and within the Fort Point Channel include both vertical and horizontal obstacles. These include bridges, above- and below-ground utilities, abandoned pilings and existing fender piles, piers and docks.

Six bridges cross the Fort Point Channel. A seventh, the New Northern Avenue bridge, is currently under construction and its pilings have been installed south of the existing Northern Avenue bridge. Table 3-16 lists each of the bridges by type, vertical clearance when closed or down, and width when open (if operable).

Each of the former bridges was originally designed and constructed so that it could be opened for navigation. However, all but the Northern Avenue and Penn Central bridges are inoperable or now of a fixed span type[6]. Currently, the Summer Street bridge is missing all the mechanical components needed to open the bridge, while the Congress Street bridge is missing many of the mechanical and all of the electrical components and has been welded shut in some locations. The Dorchester Avenue bridge has been rebuilt as a fixed span. The Penn Central bridge is operable, while the Broadway bridge is not. The City of Boston has plans to repair the Congress and Summer Street bridges in the next several years, making each a fixed span bridge.

TABLE 3-16: FORT POINT CHANNEL BRIDGE CLEARANCES

Bridge	*Type*	*Vertical Clearance (feet-MHW)*	*Horizontal Clearance (feet)*
New Northern Avenue	*Fixed*	*17.0*	*--*
Northern Avenue	*Swing*	*7.6*	*75.6 (W) 76 (E)*
Congress Street	*Bascule**	*6.5*	*75*
Summer Street	*Retractile**	*4.6*	*51*
Dorchester Avenue	*Fixed*	*4.6*	*42*
Penn Central	*Bascule*	*8.4*	*44.3*
Broadway	*Swing**	*23.8*	*50*

* *Inoperable*

Source: U.S. Army Corps of Engineers, 1980.

[6] Mr. Joseph Masotta, Superintendent, Bridge Operations and Maintenance, City of Boston Department of Public Works, personal communication.

Currently, the Northern Avenue bridge is the first barrier to navigational entry to the Fort Point Channel. At mean high water (MHW), clearance beneath the bridge is 7.6 feet. However, the bridge is operational and opened upon demand except between the hours of 7:00 a.m. and 9:00 a.m. Upon the completion of the New Northern Avenue bridge, the existing Northern Avenue bridge is to be locked in an open position and the new bridge will become the first barrier to channel navigation. The new bridge will have a relatively level fixed span with a MHW clearance of 17 feet.

The Congress Street and Summer Street bridges represent the next two barriers to upstream navigation of the channel. As noted above, these are effectively fixed span bridges. MHW clearances at the center of these bridges are 6.5 and 4.6 feet, respectively. At points one quarter the distance across these bridges the MHW clearances are 4.6 and 1.1 feet. Navigation beneath these bridges is limited to the center span area due to numerous other in-water obstructions, as discussed in the following section.

The principal horizontal constraints to navigation in the Fort Point Channel are associated with the existing bridges and include bridge abutments and fender piles. The former federal 175-foot-wide navigational channel in the Fort Point Channel remains unobstructed and offers straight line navigation from the mouth of the channel to the Dorchester Avenue bridge. The width of this channel does narrow at each channel bridge, as detailed above in Table 3-16.

Navigation beneath the Northern Avenue bridge is limited primarily by clearance, although fender piles are present in several areas. Navigation beneath the Congress and Summer Street bridges is limited to the center of the bridges, beneath what were once the moveable span sections. Existing fender piles, as well as a Boston Water and Sewer Authority water main immediately upstream of the Congress Street bridge, preclude navigation beneath these bridges outside of the former federal channel.

3.7.4.2 Navigational Use of the Fort Point Channel

Navigational destination points within the Fort Point Channel are limited primarily to points at the mouth of the channel and within the basin between the Northern Avenue and Congress Street bridges. Upstream of the Northern Avenue bridge, there are no public access points to or from the water and, with the exception of a small dock at the Gillette Company process water outfall and floats being stored in the middle of the Summer Street/Dorchester Avenue basin, there are no public or private destination or access points upstream of the Congress Street bridge.

Navigational uses in the basin upstream of the proposed Transitway crossing include the Boston Tea Party Ship and Museum boat, barge, and pier located at the center of the Congress Street bridge; the Harbor Rowing Club and Chelsea Office Boat and Marina on the western side of the channel; and the Lightships Restaurant, the boat docks, and Farrell Ocean Services on the eastern side of the channel. These are all private entities and do not allow unrestricted public access to and from the water.

With the exception of the Harbor Rowing Club, which uses the channel for recreational small craft boating, most of the navigation in the channel is destination related. This includes recreational craft docking at the Lightships Restaurant and Chelsea Office and Marina and lobster boats that operate to and from the Hook Lobster and Neptune Lobster and Seafood companies adjacent to the Northern Avenue bridge. Generally, boating in the channel is restricted to rowboats and power boats of under 40-foot length which can navigate beneath the Northern Avenue bridge[7]. Such vessels can essentially turn within their own radius and have no difficulty in navigating within the 540-foot-wide Northern Avenue/Congress Street basin. There is insufficient clearance beneath the Northern Avenue bridge for masted vessels; hence, the bridge must be opened for any such vessel

[7] Lt. Eric E. Hahn, Boston Harbor Master, letter communication, August 19, 1992.

entering the channel. Navigation beyond the first basin by a masted vessel is precluded by the low clearance of the Congress and Summer Street bridges and their inability to be opened.

The Harborwalk is continuous along the eastern side of the Northern Avenue/Congress Street basin and open to the public. There is, however, no public access from the Harborwalk to the water within this, or any other of the basins in the Fort Point Channel.

The basin between the Congress and Summer Street bridges is bordered by on-street parking on the western side and office buildings on the eastern side. The Harborwalk is continuous on the eastern side of the channel. Navigation in this basin is essentially limited to straight line passage via the center channel. Existing fender piles and a City of Boston water main preclude access to other points in this basin. Several combined sewer overflow (CSO) pipes also discharge into this basin. No private or public docking facilities or destination points are located in this basin.

The basin between the Summer Street and Dorchester Avenue bridges is the largest and least utilized of the channel. It is bordered by Dorchester Avenue and the U.S. Postal Service facility on the western side, and the Gillette Company, parking lots, and the Channel nightclub on the eastern side. The Harborwalk is continuous only on the northern end of the eastern side of the basin. Fender piles are located on both sides of the channel. A raft of boat floats is currently being stored in the center of the basin, and navigation to these floats is possible via the eastern side of the channel. The Gillette Company's industrial cooling water intake and discharge structures are located at the southern end of this basin, and a small boat dock is located adjacent to the water intake. No public destination or access points are located in this basin.

Few navigational opportunities exist in the basin beyond the Dorchester Avenue bridge. This portion of the channel is shallow, narrow, and crowded with fender piles. Hence, navigation and maneuverability are limited. No private or public destination points are in this section of the channel. Land access is possible near the Roxbury CSO outfall at the head of the channel, where the vertical channel walls give way to sloping banks.

Future uses of the various basins of the Fort Point Channel are uncertain but may include CSO abatement, additional rowing, small boat docking, public water transportation, and a continuous harborwalk. Long-term future uses under consideration by the Boston Redevelopment Authority include water-oriented recreational activities, environmental enhancement projects, additional office/working uses, additional restaurant/retail uses, a marina, and harbor safety facilities.

3.7.5 Industrial Water Use

There are four known users of saltwater from the Fort Point Channel: The Gillette Company, James Hook and Company, Neptune Lobster Company, and the New England Aquarium. Of these, the Gillette Company is by far the most significant user, having a withdrawal capacity of 57.6 million gallons per day (mgd) and, as of August 1983, an average withdrawal of 37.0 mgd. The Gillette cooling water intake is located approximately 300 feet east of the Dorchester Avenue bridge and consists of a 72-inch gravity flow pipe and an 18-inch pumped intake. Spent cooling/process water is discharged through a 42-inch diameter gravity flow pipe and a 24-inch-diameter pumped outflow at a point 200 feet further east along the channel.

James Hook and Company and the Neptune Lobster Company withdraw approximately 5.0 and 1.0 mgd of saltwater from the Fort Point Channel, respectively. The water is utilized for the maintenance of livestock in holding tanks. The facilities and their intakes are located on either side of the Fort Point Channel immediately adjacent to the Northern Avenue bridge.

Finally, the New England Aquarium withdraws approximately 0.15 mgd of saltwater from the Boston Inner Harbor at a point immediately north of the mouth of the channel. This water is used primarily for the support of marine displays.

3.8 EXCAVATE CHARACTERIZATION

Construction of one of the Transitway Alternatives could generate up to 637,500 cubic yards of excavated and dredged material, depending upon the alternative and construction scenarios selected. This material would likely consist of fill, sand and gravel, glacial till, marine clays, and dredged mucks, all of which may be clean or contaminated.

The chemical and physical characteristics of the excavated material will, to a large degree, dictate its method of handling and disposal during construction of any of the alternatives. Information detailing the type and quality of sediment present along the Transitway alignment is presented in this section. Excavated or dredged material volumes and disposal or reuse options are reviewed and discussed in Chapter 5, Section 5.9.

In order to better qualify and quantify the material to be encounted, a site specific subsurface investigation and sediment sampling program was conducted for the length of the Underground Transitway. This program was conducted subsequent to, and utilizing information developed in, the land use assessments conducted previously, as discussed below.

3.8.1 Historical and Current Industrial Land Use

Reports of the historical and current industries and land use, subsurface and/or channel investigations and listed DEP disposal sites to be investigated along the Transitway alignment were reviewed in the DEIS/SDEIR as a preliminary assessment of the sediments likely to be encountered during construction of any of the Transitway Alternatives. Based on that review, much of the land along the proposed Transitway alignment, particularly in the area east of the Fort Point Channel, is comprised of former harbor and coastal areas that were filled during the development of Boston between the early 1800s and the early part of the twentieth century. Industrial development along the alignment includes railroad, shipping, paint and printing, iron foundries, cotton, wool, leather, and tin manufacturing, and power-related industries such as electrical, coal gasification, and oil and coal storage.

Current industries that may have had an impact on alignment sediments were identified through research of DEP sites lists and files for the City of Boston. In updating information on current industries in the alignment area, thirteen DEP locations with a release of oil or hazardous materials on or near the alignment were identified (DEP List of Confirmed Disposal Sites and Locations to Be Investigated (August 1993). The approximate locations of these sites, including the DEP site list name and number are shown on Figure 3-17. In addition to the known and listed sites, several industries that commonly use oil or hazardous materials exist along or near the Transitway alignment. These include electrical transformer sites, printing companies, leather companies, and other mechanical manufacturing companies.

3.8.2 Excavate Characterization Program

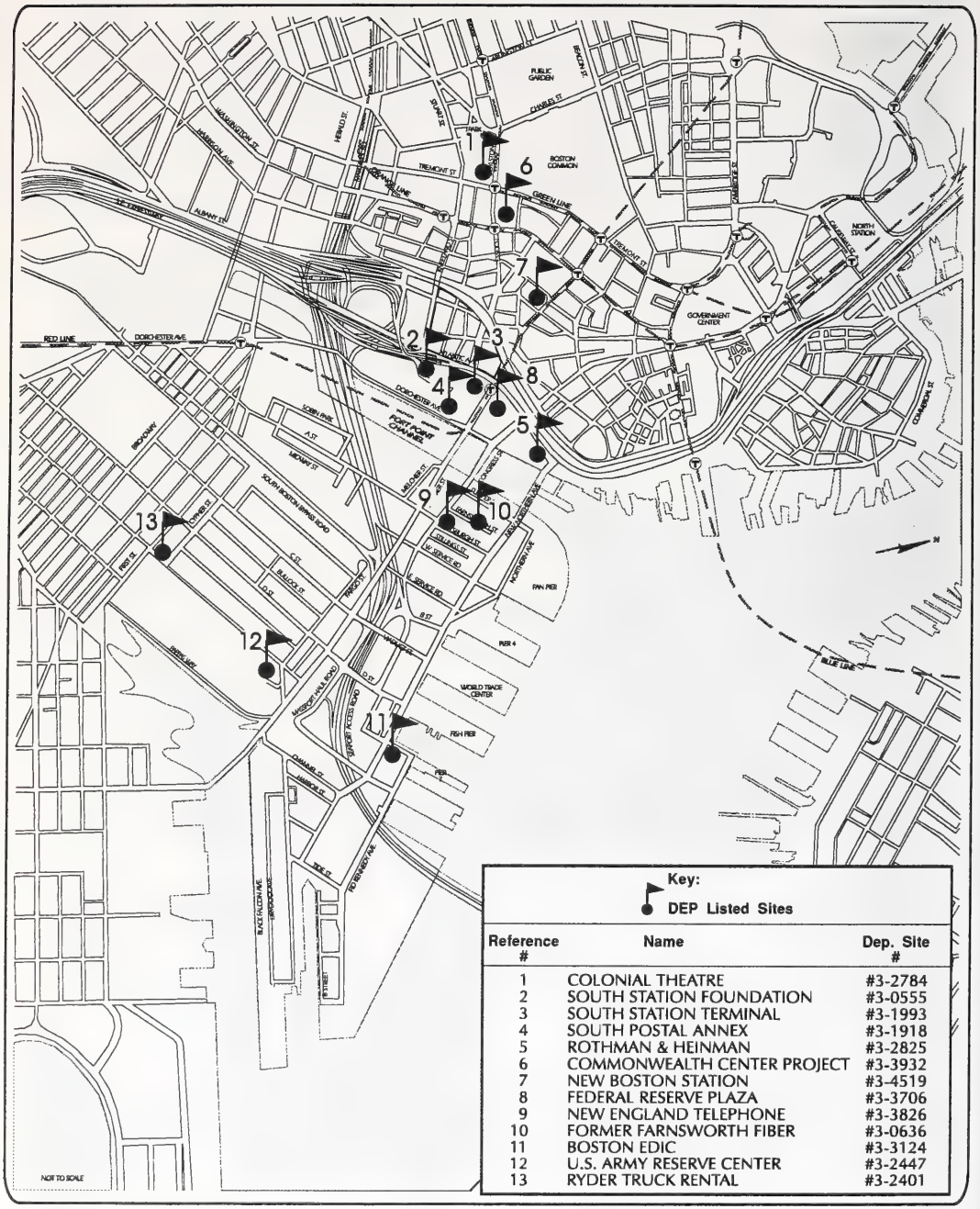
Review of the above historical and current industrial land use suggested the need for further chemical and physical characterization of the Transitway alignment sediments. Toward this end, a Transitway alignment sediment characterization program was developed and implemented. The results of this program are described below, and have been used to assess disposal alternatives, as reviewed in Chapter 5, Section 5.9.

The sediment characterization program consisted of twenty-four borings at approximately 200-foot intervals along the Full Build Transitway corridor. The approximate boring locations are shown on Figure 3-18. The actual boring locations were determined in the field based upon access, location of underground utilities, and other factors that influenced the drilling in the specified location.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-17
Approximate Locations
DEP Listed Disposal Sites
Near Transitway
Alignment



Reference #	Name	Dep. Site #
1	COLONIAL THEATRE	#3-2784
2	SOUTH STATION FOUNDATION	#3-0555
3	SOUTH STATION TERMINAL	#3-1993
4	SOUTH POSTAL ANNEX	#3-1918
5	ROTHMAN & HEINMAN	#3-2825
6	COMMONWEALTH CENTER PROJECT	#3-3932
7	NEW BOSTON STATION	#3-4519
8	FEDERAL RESERVE PLAZA	#3-3706
9	NEW ENGLAND TELEPHONE	#3-3826
10	FORMER FARNSWORTH FIBER	#3-0636
11	BOSTON EDIC	#3-3124
12	U.S. ARMY RESERVE CENTER	#3-2447
13	RYDER TRUCK RENTAL	#3-2401

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-18
Approximate Boring Locations

Sediment samples from the overburden, fill material, and underlying native sediment were collected from each boring for laboratory quality and physical characteristic analyses. Selection of sample analysis parameters and locations were based, in part, on the above-referenced historical review and the updated DEP sites information. The sampling and analysis program also served to confirm the expected depths of various soil types along the alignment, estimate soil type volumes for disposal, and identify volumes of materials which may require special handling. Monitoring well installation and groundwater sampling were not conducted as part of this program.

Boring depths were selected based on the proposed depth of the Transitway alignment as determined from the November 1992 Design Drawings Appendix published with the transit project's DEIS/SDEIR, and the November 1992 Schematic Design Report prepared by Stone and Webster Civil and Transportation Services, Inc. Each boring was advanced to the approximate depth of the center of the proposed Transitway tunnel. Actual depths for each boring are presented in Table 3-17.

Continuous split-spoon samples were collected during boring advancement to characterize the soil types encountered. One deep and one shallow sampling point were selected for laboratory analysis at each boring location. The deep samples were collected from the approximate center of the proposed Transitway tunnel, or essentially the bottom of the boring. Deep samples were collected primarily in native soils and within the water table. Shallow samples were collected from the fill materials above the water table in each boring. Soil samples were screened for volatile organic compounds (VOCs) with a photoionization detector (PID) every two feet. In borings where VOCs were detected, soil samples were collected from depths where contaminant levels were highest. Additional samples were collected for laboratory analysis in areas where high PID readings or visual evidence of contamination was observed. Depths of the soil samples collected were altered as necessary based on the results of the PID screening and the observations of the field geologist.

3.8.3 Selection of Sampling Parameters

As described above, the types of industry and period of operation influenced the types of contaminants found in the soil. Sampling parameters were chosen to provide analytical testing in areas of known or suspected contamination with oil or hazardous materials along the alignment, and to provide the additional parameters that may be necessary for potential disposal site characterization.

Soil samples were collected from shallow and deep depths with split-spoon samplers in each of the borings. No groundwater samples were collected. Soil samples were analyzed for toxicity characteristic leaching procedure (TCLP) metals, total thirteen priority pollutant metals (PP 13), total petroleum hydrocarbons (TPH), and other parameters indicated as appropriate from site research and likely to aid in disposal site characterization. The additional parameters include sodium and water soluble chloride in native soils and in fills from historical tidelands areas, and volatile organic compounds (VOCs), acid and base/neutral extractable compounds (ABNs), polynuclear aromatic hydrocarbons (PAHs), and polychlorinated biphenyl compounds (PCBs) in shallow materials where contamination with these materials is known or suspected based on past or present use of the property. Physical parameters such as grain size, moisture content, and liquid and plastic limits were analyzed to further characterize the material for disposal or reuse options. Tables 3-17 and 3-18 list the chemical and physical analytical parameters measured for each sample, respectively.

3.8.4 Results of Sampling Program

Soil samples were collected and analyzed from twenty-three locations on land and three channel locations as part of the sampling programs. A summary of positive laboratory analytical results and applicable Massachusetts Contingency Plan (MCP) regulatory standards, as defined at 310 CMR 40.0361 and 31 CMR 40.1600, is presented in Table 3-17. For the purpose of this discussion, MCP reportable concentration standards for S-1 soils (RCS-1) are utilized.

TABLE 3-17: ANALYTICAL RESULTS OF SOIL SAMPLES

		Total Priority Pollutant Metals (in mg/kg)													
	Sample Depth (feet)	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Sodium	Thallium	Zinc
URS-RIZ1-SS101	5-11	<100	5.4	<2.0	2.2	13	20	100	0.27	<10	<1.0	<2.0	130	<1.0	110
URS-RIZ1-SS102	33-39	<100	2.6	<2.0	<2.0	9.2	12	<10	<0.25	<10	<1.0	<2.0	51	<1.0	25
URS-RIZ2-SS101	1-11	<100	4.8	<2.0	<2.0	8.4	36	240	<0.25	<10	<1.0	<2.0	NA	<1.0	330
URS-RIZ2-SS102	36-40	<100	1.2	<2.0	<2.0	9.5	12	14	<0.25	<10	<1.0	<2.0	33	<1.0	85
URS-RIZ3-SS101	1-13	<100	3.5	<2.0	<2.0	14	33	130	<0.25	10	<0.91	<2.0	NA	<0.91	68
URS-RIZ3-SS102	37-50	<100	4.7	<2.0	<2.0	22	18	20	<0.25	16	<1.0	<2.0	140	<1.0	43
URS-RIZ4-SS101	3-10	<100	4.8	<2.0	<2.0	24	22	24	<0.25	22	<1.0	<2.0	NA	<1.0	41
URS-RIZ4-SS102	43-49	<100	2.5	<2.0	<2.0	13	13	13	<0.25	13	<1.0	<2.0	51	<1.0	24
URS-RIZ5-SS101	1-9	<100	3.4	<1.8	<1.8	8	14	730	0.49	<9.2	<0.92	<1.8	NA	<0.92	240
URS-RIZ5-SS102	39-44	<120	14	<2.5	4.9	52	32	27	<0.33	37	<1.2	<1.2	320	<1.2	99
URS-RIZ6-SS101	5-9	<100	6.4	<2.0	<2.0	24	16	220	<0.25	16	<1.0	<2.0	NA	<1.0	86
URS-RIZ6-SS102	33-40	<100	2.8	<2.0	<2.0	8.8	14	<10	<0.25	<10	<1.0	<2.0	79	<1.0	20
URS-RIZ7-SS101	3-9	<100	4.8	<1.9	2.1	15	29	560	<0.25	<9.5	<1.0	<1.9	NA	<1.0	350
URS-RIZ7-SS102	15-21	<120	5.7	<2.4	2.4	43	26	33	<0.32	33	<1.3	<2.4	390	<1.3	81
URS-RIZ8-SS101	2-10	<92	4.3	<1.8	<1.8	12	21	110	<0.25	12	<0.92	<1.8	NA	<0.92	66
URS-RIZ8-SS102	NC														
URS-RIZ9-SS101	2-8	<92	3.7	<1.8	<1.8	14	12	24	<0.25	12	<0.92	<1.8	NA	<0.92	35
URS-RIZ9-SS102	21-26	<120	11	<2.5	<2.5	49	22	25	<0.33	37	<1.2	<2.5	1000	<1.2	76
URS-RIZ10-SS101	3-10	<92	1.9	<1.8	<1.8	12	17	46	<0.25	<9.2	<0.92	<1.8	NA	<0.92	35
URS-RIZ10-SS102	20-27	<120	12	2.5	5	62	37	32	<0.34	45	<1.2	<2.5	560	<1.2	100
TW-101S	0-5	NA	51.4	NA	1.34	5.86	297	32.5	ND	19.0	NA	NA	NA	NA	41.6
TW-101M	15-20	NA	29.8	NA	3.76	46.4	140	432	2.67	20.3	NA	NA	NA	NA	212
TW-101D	28-30	NA	15.4	NA	ND	7.89	65.8	43.2	2.98	4.78	NA	NA	NA	NA	29.7
TW-102S	0-5	NA	23.9	NA	11.5	247	368	592	3.13	58.7	NA	NA	NA	NA	706
TW-102M	8-10	NA	35.5	NA	6.37	62.0	44.7	19.6	ND	36.6	NA	NA	NA	NA	103
TW-102D	23-25	NA	28.7	NA	7.11	70.7	49.9	22.5	0.56	46.4	NA	NA	NA	NA	109
TW-103S1	0-4	NA	26.8	NA	12.2	305	408	508	5.66	66.8	NA	NA	NA	NA	651
TW-103S2	4-5	NA	ND	NA	ND	68.4	36.5	24.9	0.75	38.4	NA	NA	NA	NA	98.2
TW-103M	8-10	NA	ND	NA	ND	73.4	35.7	18.3	0.56	38.6	NA	NA	NA	NA	83.3
TW-103D	32-34	NA	ND	NA	ND	48.3	31.6	17.2	0.34	33.0	NA	NA	NA	NA	79.0
TW-104S	0-2	NA	29.4	NA	5.36	77.8	162	276	0.61	29.6	NA	NA	NA	NA	328
TW-104D	12-14	NA	11.0	NA	3.00	40.6	310	162	0.46	18.6	NA	NA	NA	NA	206
TW-105S	0-5	NA	ND	NA	2.87	27.2	33.6	89.6	ND	17.6	NA	NA	NA	NA	62.9
TW-105D	11-13	NA	ND	NA	3.06	35.7	23.5	21.6	ND	22.1	NA	NA	NA	NA	57.2
TW-106S	0-5	NA	11.2	NA	3.04	15.3	182	421	1.22	25.3	NA	NA	NA	NA	247
TW-106M	15-17	NA	ND	NA	0.86	8.08	30.2	188	1.40	5.83	NA	NA	NA	NA	115
TW-106D	39-41	NA	ND	NA	4.82	67.7	39.6	21.5	0.46	39.3	NA	NA	NA	NA	99.1
URS-RIZ13-SS101	3-7	<130	3.8	<2.5	<2.5	19	7.1	14	0.38	14	<1.3	<2.5	<130	<1.3	42
URS-RIZ13-SS102	25-31	<100	8.4	<2.0	4.5	48	25	30	<0.25	34	<1.0	<2.0	1800	<1.0	78
URS-RIZ14-SS101	3-9	<100	11	<2.0	2.5	47	30	32	<0.25	37	<1.0	<2.0	360	<1.0	76
URS-RIZ14-SS102	27-31	<98	3.2	<2.0	<2.0	15	12	<9.9	<0.25	12	<1.0	<2.0	2200	<1.0	27
URS-RIZ15-SS101	1-5	<100	8.8	<2.0	2.2	20	260	760	0.58	24	<1.0	<2.0	200	<1.0	210
URS-RIZ15-SS101	13-17	<100	5.4	<2.6	<2.6	23	15	31	<.32	18	<1.3	<2.6	590	<1.3	43
URS-RIZ16-SS101	3-7	<100	4.4	<2.0	<2.0	15	33	140	0.47	13	<1.0	<2.0	<100	<1.0	150
URS-RIZ16-SS102	13-15	<100	6.6	<2.0	<2.0	40	22	22	<0.25	32	<1.0	<2.0	540	<1.0	69
URS-RIZ17-SS101	1-5	<100	4.4	<2.0	<2.0	10	42	110	0.20	<10	<0.93	<2.0	160	<0.93	120
URS-RIZ17-SS102	19-25	<100	7.1	<2.6	<2.6	34	25	47	0.34	27	<1.3	<2.6	1200	<1.3	64
URS-RIZ18-SS101	3-6	<100	8.9	<2.0	<2.0	35	50	90	<0.25	28	<1.0	<2.0	39	<1.0	110
URS-RIZ18-SS012	18-22	<100	4.3	<2.0	<2.0	7.2	7.2	14	<0.25	28	<1.0	<2.0	500	<1.0	12
URS-RIZ19-SS101	1-3	<95	12	<1.9	2.1	25	170	1800	1.6	13	<0.93	<1.9	37	<0.93	260
URS-RIZ19-SS102	11-21	<95	2.7	<1.9	<1.9	11	13	<9.5	<0.25	<9.5	<0.93	<1.9	1400	<0.93	23
URS-RIZ20-SS101	1-5	<100	8.7	<2.0	<2.0	27	150	540	1.7	13	1.3	<2.0	550	<1.0	260
URS-RIZ20-SS102	20-27	<130	1.3	<2.5	<2.5	7.6	7.6	15	<0.32	<13	<1.3	<2.5	660	<1.3	15
RCS-1 Guideline		10	30	0.4	30	1,000	1,000	300	10	300	300	100	NA	8	2,500

NA Not analyzed; NC Not collected; ND Not detected; BDL Below analytical detection limits

TABLE 3-17: ANALYTICAL RESULTS OF SOIL SAMPLES (continued)

	METALS (TCLP, in mg/kg)												
	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Zinc
URS-RIZ1-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.3
URS-RIZ1-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.1
URS-RIZ2-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	0.7	<0.005	<0.5	<0.5	<0.10	<1.0	2.8
URS-RIZ2-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.2
URS-RIZ3-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	0.8	<0.005	<0.5	<0.5	<0.10	<1.0	0.3
URS-RIZ3-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ4-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.5
URS-RIZ4-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ5-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	0.6	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ5-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	0.6	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ6-SS101	<0.50	<1.0	<0.10	<0.10	0.3	<0.20	0.6	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ6-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	0.6	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ7-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	0.8	<0.005	<0.5	<0.5	<0.10	<1.0	0.2
URS-RIZ7-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ8-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.3
URS-RIZ9-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.2
URS-RIZ9-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ10-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ10-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.4
TW-101S	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
TW-101M	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-101D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-102S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-102M	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-102D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-103S1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-103S2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-103M	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-103D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-104S	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-104D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-105S	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
TW-105D	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
TW-106S	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
TW-106M	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-106D	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ13-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.4
URS-RIZ13-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.2
URS-RIZ14-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ14-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	0.2	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ15-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	0.3	0.9	<0.005	<0.5	<0.5	<0.10	<1.0	1.1
URS-RIZ15-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.2
URS-RIZ16-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.1
URS-RIZ16-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ17-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.4
URS-RIZ17-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.3
URS-RIZ18-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	0.1
URS-RIZ18-SS012	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ19-SS101	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	6.2	<0.005	<0.5	<0.5	<0.10	<1.0	0.6
URS-RIZ19-SS102	<0.50	<1.0	<0.10	<0.10	<0.20	<0.20	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
URS-RIZ20-SS101	<0.50	<1.0	<0.10	<0.10	0.20	0.2	1.3	<0.005	<0.5	<0.5	<0.10	<1.0	1.5
URS-RIZ20-SS102	<0.50	<1.0	<0.10	<0.10	0.20	0.2	<0.50	<0.005	<0.5	<0.5	<0.10	<1.0	<0.10
Regulatory Level	6	5	4	1	5	1,300	5	0.2	100	1	5	2	

TABLE 3-17: ANALYTICAL RESULTS OF SOIL SAMPLES (continued)

	PAHs (in ug/kg)										
	Acenaphthene	2-Chloronaphthalene	Fluoranthene	Naphthalene	Benzo (a) anthracene	Benzo (a) Pyrene	Benzo (b,k)fluoranthene	Chrysene	Acenaphthylene	Anthracene	Benzo (ghi)Perylene
URS-RIZ1-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ1-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ2-SS101	750	<300	5000	1400	2200	1600	2600	2000	<260	1500	1000
URS-RIZ2-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ3-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ3-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ4-SS101	<280	<300	2400	<220	1100	960	1600	1100	<260	410	<500
URS-RIZ4-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ5-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ5-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ6-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ6-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ7-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ7-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ8-SS101	<140	<150	980	410	530	500	860	520	<130	<120	<250
URS-RIZ8-SS101	<140	<150	<140	<110	<160	<160	<180	<160	<130	<120	<250
URS-RIZ8-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ10-SS102	<140	<150	2000	420	820	590	1100	730	<130	430	<250
URS-RIZ10-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TW-101S	ND	NA	ND	ND	ND	ND	ND	ND	NA	ND	ND
TW-101M	ND	NA	ND	ND	ND	ND	ND	ND	NA	ND	ND
TW-101D	ND	NA	2,070	ND	1,580	1,200	2,130	1,560	NA	648	ND
TW-102S	ND	NA	ND	ND	ND	ND	ND	ND	NA	ND	ND
TW-102M	ND	NA	ND	ND	ND	ND	ND	ND	NA	ND	ND
TW-102D	ND	NA	ND	ND	ND	ND	ND	ND	NA	ND	ND
TW-103S1	ND	NA	5,220	ND	ND	ND	ND	ND	NA	ND	ND
TW-103S2	ND	NA	ND	ND	ND	ND	ND	ND	NA	ND	ND
TW-103M	ND	NA	ND	ND	ND	ND	ND	ND	NA	ND	ND
TW-103D	ND	NA	ND	ND	ND	ND	ND	ND	NA	ND	ND
TW-104S	ND	NA	2,550	ND	591	1,450	2,410	1,040	NA	429	686
TW-104D	ND	NA	1,710	ND	1,050	826	1,585	1,000	NA	ND	ND
TW-105S	420	NA	3,720	ND	2,150	1,810	4,160	2,380	NA	360	570
TW-105D	ND	NA	ND	ND	ND	ND	ND	ND	NA	ND	ND
TW-106S	ND	NA	2,610	ND	1,560	ND	2,070	1,300	NA	ND	ND
TW-106M	2,210	NA	22,300	1,320	11,600	5,590	13,270	11,700	NA	6,970	1,730
TW-106D	ND	NA	ND	ND	ND	ND	ND	ND	NA	ND	ND
URS-RIZ13-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ13-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ14-SS101	<160	<190	<180	<140	<200	<240	<230	<200	<160	<150	<320
URS-RIZ14-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ15-SS101	<280	<300	740	<220	<320	<360	640	430	<260	<240	<500
URS-RIZ15-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ16-SS101	320	<300	5400	<220	2000	1500	2900	2100	<260	800	880
URS-RIZ16-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ17-SS101	740	<300	9200	410	3900	3000	5500	3900	<260	1700	1700
URS-RIZ17-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ18-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ18-SS012	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ19-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ19-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ20-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
URS-RIZ20-SS102	<280	<300	<280	<220	<320	<360	<360	<320	<260	<240	<500
RCS-1	20,000	1,000	600,000	4,000	700	700	1,400	700	100,000	1,000,000	30,000

TABLE 3-17: ANALYTICAL RESULTS OF SOIL SAMPLES (continued)

	PAHs (in ug/kg) (continued								VOCs (mg/kg)	PCBs (mg/kg) Arochlor	TPH	Chloride
	Fluorene	Phenanthrene	Dibenzo (a,h) anthracene	Indeno (1,2,3-cd) pyrene	Pyrene	1-Methylnaphthalene	2-Methylnaphthalene	Total PAH	Acetone	1254	(mg/kg)	(mg/kg)
URS-RIZ1-SS101	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	58	74
URS-RIZ1-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	56	68
URS-RIZ2-SS101	1100	5900	<480	<480	3700	<700	460	<31,440	ND	NA	NA	NA
URS-RIZ2-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	52	47
URS-RIZ3-SS101	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	1200	NA
URS-RIZ3-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<40	110
URS-RIZ4-SS101	<280	1600	<480	<480	2200	<700	<180	<15,050	ND	NA	1100	NA
URS-RIZ4-SS102	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	55	250
URS-RIZ5-SS101	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	1400	NA
URS-RIZ5-SS102	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	<53	4500
URS-RIZ6-SS101	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	<40	NA
URS-RIZ6-SS102	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	<40	340
URS-RIZ7-SS101	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND	120	NA
URS-RIZ7-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	52	190
URS-RIZ8-SS101	<140	540	<240	<240	960	<350	<90	<7,130	ND	ND	NA	300
URS-RIZ9-SS101	<140	<130	<240	<240	<140	<350	<90	<3,060	ND	ND	110	NA
URS-RIZ9-SS102	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND	<53	3000
URS-RIZ10-SS102	340	1900	<240	<240	1600	<350	<90	<11,520	ND	ND	<40	NA
URS-RIZ10-SS102	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND	<54	1200
TW-101S	ND	ND	ND	ND	ND	NA	NA	ND	ND	ND	302	NA
TW-101M	ND	ND	ND	ND	ND	NA	NA	ND	NA	NA	ND	NA
TW-101D	ND	1,000	591	540	2,580	NA	NA	13,999	NA	NA	229	NA
TW-102S	ND	ND	ND	ND	2,450	NA	NA	2,450	NA	0.14	3,640	NA
TW-102M	ND	ND	ND	ND	ND	NA	NA	ND	NA	ND	ND	NA
TW102D	ND	ND	ND	ND	ND	NA	NA	ND	NA	ND	ND	NA
TW-103S1	ND	ND	ND	ND	5,720	NA	NA	10,940	NA	0.11	13,400	NA
TW-103S2	ND	ND	ND	ND	ND	NA	NA	ND	NA	ND	ND	NA
TW-103M	ND	ND	ND	ND	ND	NA	NA	ND	NA	ND	ND	NA
TW-103D	ND	ND	ND	ND	ND	NA	NA	ND	NA	ND	ND	NA
TW-104S	ND	ND	ND	630	3,000	NA	NA	12,786	NA	ND	ND	NA
TW-104D	ND	1,200	ND	ND	2,220	NA	NA	8,591	NA	ND	ND	NA
TW-105S	370	4,490	ND	980	5,920	NA	NA	26,150	ND	ND	1,030	NA
TW-105D	ND	ND	ND	ND	ND	NA	NA	ND	NA	NA	283	NA
TW-106S	ND	2,300	ND	ND	2,720	NA	NA	12,560	NA	NA	1,550	NA
TW-106M	3,040	25,000	ND	1,860	15,500	NA	NA	122,090	NA	NA	167	NA
TW-106D	ND	ND	ND	ND	ND	NA	NA	ND	NA	NA	ND	NA
URS-RIZ13-SS101	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	<51	270
URS-RIZ13-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<40	3600
URS-RIZ14-SS101	<180	<160	<300	<300	<180	<440	<110	<3,450	ND	ND	210	740
URS-RIZ14-SS102	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	<40	2900
URS-RIZ15-SS101	<280	420	<480	<480	650	<700	<180	<7,500	ND	ND	66	140
URS-RIZ15-SS101	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	<51	160
URS-RIZ16-SS101	<280	3,400	<480	1100	4500	<700	<180	<27,330	NA	ND	3000	110
URS-RIZ16-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	65	500
URS-RIZ17-SS101	810	7,300	<480	1800	7200	<700	<180	<47,480	NA	NA	310	230
URS-RIZ17-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<53	1100
URS-RIZ18-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	250	440
URS-RIZ18-SS012	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<40	680
URS-RIZ19-SS101	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	170	54
URS-RIZ19-SS102	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	57	2000
URS-RIZ20-SS101	NA	NA	NA	NA	NA	NA	NA	570.00	570	NA	2800	220
URS-RIZ20-SS102	<280	<260	<480	<480	<280	<700	<180	<6,120	ND	ND	77	840
RCS-1	400,000	100,000	700	700	500,000		700		3,000	2,000	500	

TABLE 3-18: SUMMARY OF PHYSICAL PARAMETERS OF SOIL SAMPLES

Sample Number	Sample Depth (feet)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Limit	Grain Size by Percent (Sieve)						
URS-RIZ1-SS102	33-39	14%	NA	*	NA	0.00	0.30	6.30	46.00	69.00	83.00	90.00
URS-RIZ2-SS102	38-40	17%	NA	*	NA	0.00	0.00	1.00	27.00	61.00	86.00	96.00
URS-RIZ3-SS102	37-50	19%	27.20	15.80	11.40	0.00	1.30	1.80	3.20	6.40	15.00	30.00
URS-RIZ4-SS101	3-10	18%	19.90	15.40	2.50	15.00	32.00	43.00	62.00	72.00	80.00	86.00
URS-RIZ4-SS102	43-49	11%	18.80	13.20	4.60	0.00	9.20	14.00	23.00	29.00	37.00	46.00
URS-RIZ5-SS102	39-44	25%	44.70	23.80	20.80	0.00	0.00	0.00	0.10	0.20	0.30	0.80
URS-RIZ6-SS102	33-40	13%	15.20	12.20	3.10	2.50	11.00	17.00	28.00	38.00	50.00	64.00
URS-RIZ7-SS102	15-21	21%	36.30	18.00	18.30	0.00	0.18	0.54	0.99	1.30	1.70	6.70
URS-RIZ9-SS102	21-26	25%	35.70	20.10	15.60	0.00	0.00	0.00	0.00	0.00	0.90	2.70
URS-RIZ10-SS102	20-27	26%	50.20	22.60	27.60	0.00	0.00	0.40	0.40	0.40	0.40	1.30
URS-RIZ13-SS102	25-31	21%	28.40	15.50	12.90	0.00	0.00	0.67	9.00	23.00	43.00	77.00
URS-RIZ14-SS102	27-31	22%	16.70	16.40	0.20	0.00	0.00	0.00	0.82	5.50	48.00	84.00
URS-RIZ15-SS102	13-17	22%	23.40	17.60	5.70	0.00	0.50	0.80	1.60	3.50	11.00	38.00
URS-RIZ16-SS102	13-15	23%	41.60	23.00	18.60	0.00	1.00	1.70	2.30	3.20	5.30	16.00
URS-RIZ17-SS102	19-25	21%	24.40	20.50	3.90	0.00	0.00	0.40	4.60	14.00	50.00	78.00
URS-RIZ18-SS102	18-22	19%	NA	*	NA	0.00	1.20	1.90	27.00	74.00	91.00	95.00
URS-RIZ19-SS102	11-21	21%	27.30	15.70	11.60	3.20	4.40	5.20	7.70	9.30	13.00	26.00
URS-RIZ20-SS102	20-27	18%	NA	*	NA	0.00	0.13	0.60	5.90	28.00	76.00	86.00

* Samples from RIZ-1, RIZ-2, RIZ-18, and RIZ-20 found to be non-plastic.

In general, elevated levels of TPH, PAHs, and metals such as lead were found, primarily in the fill materials. TCLP lead levels exceeded the regulatory level of 5.0 µg/l in one fill sample from South Boston. Elevated levels of acetone were found in one fill sample; no other VOCs were detected. PCBs were not detected in any of the soil chemical analyses, but Arochlor 1254 was detected in surficial marine sediment samples from borings TW-102 and TW-103 in the Fort Point Channel. Native soils were generally high in sodium and water soluble chloride, particularly in South Boston.

A description of the materials encountered along the alignment of the Transitway and soil sample analytical results are presented below; to correlate results to construction segments of the Transitway, construction contracts are referenced in parentheses.

3.8.4.1 South Station to Fan Pier

Soil samples collected along the Transitway alignment from South Station to Fan Pier include samples collected from borings TW-101 and 106 on the west side of the Fort Point Channel, borings TW-102, 103, and 104 within the channel, and boring TW-105 on the east side of the channel. Materials on the western side of the Fort Point Channel (CC03A) were found to consist of approximately 26 feet of fill containing sand, gravel, brick, and wood. Below the fill is a layer of silt with shells which, in turn, overlies peat. Grey, silty clay was found from a depth of approximately 31.5 feet to the bottom of the borings at 50 feet. Materials on the eastern side of the Fort Point Channel (CC07) consist of approximately 5 feet of sand and gravel fill, underlain by fine sand with some silt to 37 feet. Grey-blue clay was encountered below this depth.

Surficial samples from the landside boring TW-101 contained levels of arsenic that were above the MCP RCS-1 limit of 30 mg/kg. Elevated levels of the PAHs benzo(a)pyrene, benzo(a)anthracene, benzo(b,k)fluoranthene, chrysene, and ideno(1,2,3-cd)pyrene were detected in soil samples from landside borings on both sides of the Fort Point Channel.

Marine sediments within the Fort Point Channel (CC05) were generally found to consist of 4 to 20 feet of surface muck sediments underlain by clay and till. Analytical data from soil samples collected from channel borings TW-102, TW-103, and TW-104 indicate that levels of arsenic, lead, and several PAHs are above the RCS-1 guidelines. In addition, the near-surface sediments in the channel were found to be within Category III regulatory guidelines of the Massachusetts Criteria for Classification of Dredge or Fill Material (314 CMR 9.00), due to their elevated concentrations of cadmium, copper, lead, mercury, and zinc. Category III dredged material is deemed unsuitable for ocean disposal. Deeper sediments from the channel borings were generally within the Category I guidelines, with the exception of arsenic, cadmium, and mercury. Category I dredged material is deemed suitable for ocean disposal. Contaminant levels demonstrate a marked decrease between the surficial muck deposits and the underlying clays. Contaminated near-surface deposits were found to range in depth from 4 to 20 feet.

3.8.4.2 Fan Pier to the World Trade Center

Soil borings along this portion of the Transitway alignment were proposed approximately every 200 feet, from Farnsworth Street to D Street (CC07, CC08 and CC09). Due to access constraints, however, borings were not installed in the vicinity of World Trade Center Station (CC09). Available data from the CA/T Project were reviewed for information on soil conditions in this area. Soil borings RIZ-13 to RIZ-20 were installed between Farnsworth Street and the current World Trade Center parking lot.

In general, the material from Farnsworth Street to the eastern portion of Courthouse Station consisted of 3 to 5 feet of sand and gravel fill overlying marine silts and clays. These sediments included grey silt and clay to approximately 15 feet, underlain by interbedded silty clay and fine sand to a depth of 31 feet. Shell fragments were common in the silt and clay. The upper 5 to 7 feet of the marine sediments appeared to have been reworked, and therefore will be classified as fill for the purpose of discussion in subsequent sections of this document. Native soils collected in this

area contained 21 to 22 percent moisture, and consist predominantly of inorganic clay of low to medium plasticity based on Atterberg limits. Sandy lenses with a low plasticity index are interbedded with the clays. With the exception of surficial soils collected from RIZ-15, which contained elevated levels of lead, soil samples collected from these borings were within the RCS-1 reportable concentration guidelines. Lead levels in the sample from RIZ-15 did not exceed the TCLP regulatory level.

Boring data from RIZ-16, RIZ-17, RIZ-19, and RIZ-20 indicate that sand and gravel fill are present to a depth of approximately 12 feet, followed by a few feet of reworked marine sediments and brick fragments. The fill is underlain by 10 to 15 feet of interbedded silty clay and sand followed by a fine to medium sand unit that thickens to the east. A thin, 6-inch layer of black organic silt was present at a depth of 23 feet in each of the borings. As with the soils described above, soils collected from these borings generally consisted of silty clays with low to medium plasticity and moisture contents of 21 to 23 percent. The interbedded sandy unit is non-plastic, with a natural moisture content of approximately 18 percent.

Soil samples from the fill material in RIZ-16 and RIZ-17 exceeded the RCS-1 reportable concentrations of several PAH compounds. TPH was above the reportable concentration of 500 mg/kg in fill samples collected from RIZ-16 and RIZ-20. The fill sample from RIZ-19 exceeded regulatory levels for TCLP lead. Acetone was detected in fill samples from RIZ-20, and VOC headspace readings and a solvent odor were detected to a depth of approximately 20 feet.

Soil encountered in boring RIZ-18 was similar to the materials discussed above, except that the sand and gravel fill extended to only a depth of 4 feet, followed by approximately 6 feet of reworked marine sediments. Silty clay and interbedded sand extended to a depth of 18 feet, followed by fine to coarse sand, coarsening with depth. Soil samples analyzed from RIZ-18 did not exceed regulatory levels.

Based upon data from the CA/T Project's Preliminary Design Report for the Design Section D001A, the Journal of the Boston Society of Civil Engineers, and the CA/T Soil Characterization Report (JMCA, 1989), the soils of the World Trade Center Station area are comprised of sand and gravel fill with cinders and bricks to a depth of approximately 4 feet, followed by approximately 17 feet of reworked marine sediments. Silty clay and sand extend to a depth of about 29 feet, followed by silty clay and clay.

Elevated levels of arsenic, lead, mercury, and TPH have been detected in the fill materials in the vicinity of World Trade Center Station. Based upon the borings advanced for the Transitway Project in other parts of South Boston, it is likely that PAH levels will also exceed the RCS-1 reportable concentrations in the fill materials in the vicinity of World Trade Center Station.

3.8.4.3 Boylston Station to South Station

Soil borings RIZ-1 through RIZ-10 were installed to characterize the soils in the area of the project between Boylston Station and South Station.

Soil encountered in borings RIZ-1 through RIZ-3 (CC22) consisted of approximately 13 to 14 feet of sand and gravel fill that included glass, brick, wood, asphalt, rubber, plastic, and other miscellaneous materials. Near Boylston Street, the fill is underlain by silty fine sand grading to coarser sand with depth. Occasional clay and silt layers were noted. In general, the material is non-plastic, with moisture content ranging from 14 to 17 percent. Further east of Boylston Street, the fill is underlain by interbedded clay and silty fine sand to approximately 30 feet, followed by oxidized sand that grades coarser with depth. The interbedded silty fine sand and clay has a low plasticity index, and a moisture content of about 19 percent. PAHs and TPH exceeded the RCS-1 regulatory levels in some of the fill material in this area.

From Chauncy Street to South Street (CC21), materials encountered in the soil borings generally consisted of 8 to 10 feet of sand and gravel fill with brick, metal, and asphalt fragments. The fill was underlain by silt and interbedded silty sand and clay to a depth of approximately 35 to 40 feet. Samples of the native soils consisted of non-plastic sands with moisture contents of 11 to 13 percent, and inorganic clays with low to medium plasticity and moisture contents of 21 to 25 percent. Glacial till was encountered in the lower 5 to 10 feet of borings RIZ-4 and RIZ-6. Lead levels in the fill material from RIZ-5 at the intersection of Avenue de Lafayette and Kingston Street exceeded RCS-1 concentrations. TPH and PAH levels in the fill material from this portion of the alignment were also found to exceed RCS-1 concentrations. Water soluble chloride was also elevated in the deep sample collected from the clay encountered in RIZ-5.

The soil encountered in borings along the portion of the alignment from South Street to Atlantic Avenue (CC04) consisted of 8 to 14 feet of sand and gravel fill with trace amounts of brick, plastic, coal, wood, cinders, slag, concrete, and other materials. The fill was underlain by clay with interbedded silt and clay to a depth of 26 feet. The clay is of medium plasticity, with moisture contents of about 26 percent. Samples collected from the fill material in RIZ-7 off Essex Street contained lead levels greater than the RCS-1 concentrations for lead. PAH levels in the fill material from the CC04 area also exceeded regulatory levels. Sodium and water soluble chloride levels are elevated in the native materials near Atlantic Avenue.

3.9 ARCHAEOLOGICAL RESOURCES STANDARDS AND CONDITIONS

3.9.1 Regulations

A number of federal and state regulations have been promulgated to preserve and protect significant archaeological resources. The following laws provide federal protection for such resources.

The National Historic Preservation Act (NHPA) of 1966 directs the Secretary of the Interior to maintain a list of buildings, sites, districts, structures, and objects of local, state, or national significance in American history, architecture, archaeology, and culture. Provision of this list — called the National Register of Historic Places — is authorized under Section 101(a) of the NHPA. Section 106 of the NHPA directs federal agencies to identify and assess the impact of all federally funded or licensed projects on historical/archaeological resources included in or eligible for inclusion in the National Register. NHPA also established the Advisory Council on Historic Preservation. The Advisory Council is an independent government agency established to develop regulations and procedures to enforce the terms of Section 106. In Massachusetts, the NHPA program is administered by the Massachusetts Historical Commission which serves as the State Historic Preservation Office (SHPO).

Section 4(f) of the Department of Transportation Act of 1966 further protects archaeological resources. It states that no Department of Transportation project will be approved if it requires the use of land from historic sites of local, state, or national significance, unless there is no prudent or feasible alternative, and the project includes adequate planning to minimize damage to the historic property.

Executive Order 11593 issued in May 1971 expanded the responsibilities of federal agencies under the *National Environmental Policy Act (NEPA)* to identify and protect significant historic and archaeological properties. Section 1 of the Order directs federal agencies to institute procedures to ensure that federal programs contribute to the preservation of sites, structures, and objects of historic, architectural, and archaeological significance. Federal agencies must inventory and nominate any property under their jurisdiction that appears to qualify for listing in the National Register. Any questions concerning eligibility must be deferred to the Secretary of the Interior for a determination. Federal agencies must also allow the Advisory Council on Historic Preservation an opportunity to comment on the effects of a federal program or project on any property that might be eligible for listing in the National Register.

Finally, the *Archaeological and Historic Preservation Act of 1974* provides for the preservation of all historical and archaeological data that would otherwise be lost or destroyed by any federally funded or

licensed project or program. Up to one percent of a project's cost can be spent on the recovery of archaeological data. The agency can either administer the program itself or transfer funds to the Secretary of the Interior to administer the program. In addition to scientific excavation or collection, the funding extends to analysis and publication of the investigation's results.

State regulations providing protection for archaeological resources consist of Chapter 9 of the Massachusetts General Laws (M.G.L.), the Underwater Archaeological Act, the Massachusetts Environmental Policy Act (MEPA), and a series of laws protecting unmarked human burials (M.G.L. Ch. 7 § 38A; M.G.L. Ch 9. § 26A and 27C; M.G.L. Ch. 38 § 6B; M.G.L. Ch. 114 § 17).

Chapter 9, M.G.L., Sections 26 and 27C, established the Massachusetts Historical Commission and the Office of State Archaeologist. This Chapter also established a permit system whereby any person or agency conducting field investigations must first obtain a permit from the State Archaeologist. Likewise, the Underwater Archaeological Act stipulates that a permit must be obtained before any underwater salvage of cultural material can be initiated. The unmarked human burial laws provide for the delineation of the borders of historic cemeteries, as well as the analysis, repatriation, and reburial of any excavated human remains. Finally, MEPA sets forth procedures for studying the impacts of projects on the natural and cultural environment.

3.9.2 Survey of Archaeological Resources

In compliance with Section 106 of the National Historic Preservation Act, a Reconnaissance Archaeological Survey was conducted for the project, initiating the process of inventorying archaeological resources in or near the project area and proposed alignment. Using existing documentary sources, a walkover inspection, and consultation with informants, including the CA/T Project's consulting archaeologist, the survey identified areas of archaeological sensitivity and potential significance in accordance with the National Register of Historic Places. Documentary sources included cultural resource management reports, land-use histories, and primary cartographic sources. A discussion of these sources, including a list of informants consulted, is included in the archaeological reconnaissance survey report for the project on file at the Massachusetts Historic Commission. These results were reviewed with the Massachusetts SHPO. In light of the lengthy schedule for implementation of the Full Build Transitway Alternative, in which construction of the proposed western end of the alignment would not occur for approximately ten years, an intensive archaeological survey for the single area of archaeological sensitivity identified within the Boston Common may be conducted when more detailed plans become available and construction techniques are refined.

The results of this survey and an assessment of archaeological sensitivity of various sections of the project area are described below.

3.9.2.1 Fort Point Channel and Russia Wharf

Throughout the seventeenth and eighteenth centuries, the Fort Point Channel area was part of South Bay, also known as South Cove. The present configuration of the channel did not begin to emerge until after 1830. During this period, maritime development began in the area with the construction of numerous wharves and "wharfing out," or filling the spaces between the wharves. Large sections of South Bay were also filled on both the west and east sides to create land for construction of residential, commercial, and industrial buildings. A series of dredging operations conducted in the latter part of the nineteenth century, the first decade of the twentieth century, and the 1950s are assumed to have destroyed any potential archaeological resources.

Russia Wharf's early history is difficult to discern from historic maps. Bonner's 1722 map of Boston shows a wharf in the vicinity of the modern Russia Wharf; throughout the eighteenth and early nineteenth centuries the wharf developed along with the rest of the Atlantic Avenue shoreline. The wharf received its name from its connection with an aggressive Baltic trade carried out by Thomas Russell (active 1784-96) and Henderson Inches (active 1800-1857). Structures supporting the mercantile trade probably including warehouses, sheds, ropewalks, and other maritime buildings along the surface of the wharf that are no longer extant. Based on other wharf

excavations, it is likely that trash disposal would not have been in pits or middens; instead, the trash would have been jettisoned overboard into the harbor, leaving the wharf relatively clear of artifacts and subsurface features. Therefore, any archaeological potential would be limited to the deeply-buried structural remains of earlier wharves.

The Great Boston Fire of 1872 swept over Russia Wharf, apparently destroying all standing structures on its surface. Between the time of the disaster and 1876, the City of Boston extended Congress Street out over the wharf, an operation that involved bringing in large quantities of fill from the fire to level the devastated area. In 1897-8 the three existing Classical Revival buildings (known as the Russia Wharf Buildings) were erected on the site, a process that involved the setting of substantial foundations through the former wharf to a depth of almost 50 feet below the present ground surface. In 1980, these buildings were listed on the National Register of Historic Places.

Based on the site's development, it seems likely that the extension of Congress Street over the wharf and construction of the foundations of the existing buildings have compromised any archaeological integrity of earlier wharf remains. Excavation of the foundation and driving of the pile clusters would have certainly cut through any timber cribbing or framing from the 1722 wharf. In the absence of a known archaeological resource, no further archaeological survey is recommended for the Russia Wharf area of the project.

3.9.2.2 South Boston Piers

Like the Fort Point Channel, the South Boston Piers area was open water within South Bay during the seventeenth and eighteenth centuries. It was not until the late nineteenth century that this area was filled and subsequently used for commercial purposes. Given the extent and nature of filling in this area and its recent development, this area exhibits little archaeological sensitivity.

3.9.2.3 Boston Common/Tremont Street

Almost all of downtown Boston was part of the original Shawmut Peninsula and within the seventeenth century Boston settlement. Boston Common was established by 1634 in the first decade of settlement, and Tremont Street, previously a cart path, was formally laid out in 1784.

The Tremont Street and perimeter sections of this area may have contained important archaeological resources associated with land use from the early seventeenth and eighteenth centuries through the nineteenth century. However, the combined impacts of late nineteenth century subway construction and twentieth century building construction and deep utilities installation indicate that the probability of surviving archaeological resources is low, with one notable exception. The extreme western edge of the project area and the existing Boylston Station abut potentially undisturbed Boston Common lands.

Boston Common is the oldest public park in the United States. The southeastern corner of the Common, including the Central Burying Ground, has a long and interesting history. Part of the original Common purchase in 1634, the area remained as open space and pasturage until 1756, when the town purchased the former Fitch pasture for use as a burying ground to relieve pressure on the city's overcrowded graveyards. This new yard was known first as the Common and then the South Burying Ground; it acquired its present name, the Central Burying Ground, at the turn of the nineteenth century.

Despite the town's lack of possession of the corner lot, some burials did occur outside the marked area in the eighteenth and nineteenth centuries. Archaeological monitoring of the reconstruction of the Deer Park Maintenance Facility resulted in the documentation of several tombs and vaults that extended from the interior of the burying ground and under its east wall to the open space beyond the marked limits.

Archaeological fieldwork in New York and Philadelphia suggests that urban burying grounds can and do extend farther than their marked boundaries. The possibility of unmarked burials surviving in the Deer Park/Boylston Street Station area must be considered as moderate to high; although most historic maps show the area as a open space throughout the eighteenth and nineteenth centuries, there are examples in New York and Newport of people considered "outside the community" buried beyond the walls of the cemetery. These "outsiders" have included African Americans, British soldiers, and the poor, among others. In Boston, a 1714 petition from the city's gravediggers asked the town to appoint a separate burying place for "strangers and Negroes"; although the petition predates the establishment of the Central Burying Ground, it certainly sets a precedent for possible later activities.

Previous archaeological efforts on the Common have uncovered evidence of a wide range of both prehistoric and historic activities that occurred throughout Boston's history. It is possible that other significant, National Register-eligible archaeological resources have survived in the southeast corner of the Common. These could include evidence of the British detail of marines who camped there in 1775 and remains of two artillery-company structures erected at the turn of the nineteenth century, including a gun shed and a hearse house. Evidence of these and other structures may have been sealed when the area became a deer park in the 1860s and could have survived the construction of the Boylston Street Station (1895) and the Deer Park Maintenance Facility. Furthermore, any intact areas have the potential to contain prehistoric cultural resources. Based on the site's intensive use as a burial ground and military encampment, intensive archaeological survey is recommended for any surface areas impacted by construction of the Transitway.

The lack of prior disturbance in this section also suggests that prehistoric archaeological remains, if present, may survive. Anticipated archaeological resources within this area may include prehistoric sites, land use evidence and possible structural remains associated with historic domestic occupation, human remains associated with the Central Burying Ground, and landscaping evidence associated with the development of the eighteenth century Tremont Mall and Boston Common. Therefore, this area is assessed as possessing moderate to high archaeological sensitivity.

3.9.2.4 Avery Street/Hayward Place/Avenue de Lafayette

This section of the project corridor is located in one of the oldest areas of Boston and was a major focus of settlement during the early plantation period. Evidence of several taverns and a large number of artisans indicate a mixed commercial/residential land use pattern in the area through the eighteenth century. During the nineteenth century, the nearby Boylston Market maintained the commercial flavor of the neighborhood.

While this area may have contained significant archaeological resources, it has also been subject to significant disturbance. The construction of several large buildings during the late nineteenth and early twentieth century as well as utility lines, some of which are buried between 20 and 30 feet below the surface, indicates that the probability of any archaeological resources surviving is low. This is especially true of the Hayward Place/ Avenue de Lafayette portion of the project area which is the product of relatively recent infill construction.

3.9.2.5 Essex Street

Essex Street is one of the oldest streets in the City of Boston, traversing a section of the Shawmut Peninsula. Essex Street and the part of the peninsula to its east was home to artisans, those involved in the maritime industries, and other commercial pursuits. During the eighteenth century, the Essex Street area continued to serve this population although, like the waterfront, it generally exhibited a mixed residential/commercial neighborhood. With the expansion of wharves in the South Cove area during the nineteenth century, the area's commercial flavor intensified.

Like the Avery Street/Hayward Place/Avenue de Lafayette section, the Essex Street area was probably rich in archaeological resources at some time prior to the growth of the urban utility system. Unfortunately, as

a major artery in the city, Essex Street has been a conduit for utility lines, some of which have been buried to a depth of 30 feet. Therefore, the area has low archaeological sensitivity.

3.9.2.6 South Station/Atlantic Avenue

The area to the east of Atlantic Avenue was originally part of the Shawmut Peninsula shoreline which was filled during the eighteenth and nineteenth centuries. It was also a focus of maritime activity as early as the seventeenth century. During the eighteenth century, commercial development of the area continued along what was then Sea Street (now Atlantic Avenue). Whitehorn's Wharf, later known as Griffin's Wharf, was the site of the Boston Tea Party. Today, this is the site of Boston Edison's substation.

The South Station/Atlantic Avenue area has undergone extensive development and associated deep foundation and utilities excavations during the twentieth century. The disturbance caused by the construction of the Boston Edison Substation and Sheraton Building, for example, indicates that it is an area of low archaeological sensitivity.

3.10 EXISTING HISTORIC RESOURCES STANDARDS AND CONDITIONS

3.10.1 Regulations

Federal, state, and municipal regulations have been promulgated to preserve and protect significant historic resources. Federal procedures governing the preservation of historic properties are incorporated in the environmental review process of the National Environmental Policy Act (NEPA), the National Historic Preservation Act (NHPA), and Section 4(f) of the Department of Transportation Act. These acts were described in detail in Section 3.9.1.

The NHPA established the following three mechanisms for the protection of historic resources:

- *The Advisory Council on Historic Preservation* is an independent government agency established to develop regulations and procedures to enforce the terms of Section 106.

- *The National Register of Historic Places* is a list of significant historic resources maintained by the Secretary of the Interior under Section 101(a) of the NHPA.

- In accordance with the *Review Process,* any federally licensed, funded, or otherwise assisted project is required, under Section 106 of NHPA, to be reviewed by the participating federal agency to determine the potential effect of the project on any National Register (NR) or National Register Eligible (NRE) site.

In Massachusetts, the NHPA program is administered by the Massachusetts Historical Commission (MHC) which serves as the State Historic Preservation Officer (SHPO). The MHC reviews federally licensed or funded projects to determine their potential impact on historic resources. Resources either listed in the National Register or eligible for inclusion are protected. Appropriate avoidance or mitigation measures must be developed to protect any significant resources. Mitigation measures must be approved by the federal agency from which funding or licensing is sought, the SHPO (MHC), and the Advisory Council.

In addition to the NHPA, historic resources are further protected by Section 4(f) of the Department of Transportation Act. This Act provides that no Department of Transportation project will be approved if the project requires the use of land from national, state, or local historic sites, unless there is no other feasible alternative and the project includes planning to minimize damage to the property.

In addition to its role as administrator of the federal NHPA program, the MHC reviews the historic impact of proposed construction projects on state historic resources through the Environmental Notification Form (ENF) of the MEPA process.

Finally, the City of Boston has a landmarks law administered by the Boston Landmarks Commission (BLC). The nature and extent of protection afforded under this legislation varies from property to property. It generally precludes modifications to the exterior, and/or occasionally the interior, of a designated landmark. Under a proposed zoning code, various categories of BLC designated properties would also be subject to anti-demolition regulations.

3.10.2 Survey of Historic Resources

A survey of historic resources that might be affected by the project alternatives was undertaken in a delineated area of the City of Boston within which impacts could occur. This area consists of the following:

- A corridor 300 feet wide along the Transitway tunnel from the proposed World Trade Center Station to Boylston Station at the intersection of Boylston and Tremont Streets, including the interior of Boylston Station;

- A corridor 300 feet wide along the surface trackless trolley routes with catenary wires from the Fan Pier portal (MOS-1) or the World Trade Center station portal (MOS-2 and Full Build) to the Boston Marine Industrial Park and to Summer/D Streets; and

- ***The two options for the proposed maintenance facility on the parcel bounded by Summer Street, Pappas Way, West First Street, and E Street.***

The survey of historic properties in the project area was undertaken in September 1991. A field survey of the route was conducted, and properties and districts listed in or eligible for the National Register and/or the State Register of Historic Places were identified. In addition, inventory forms and National Register registration forms were consulted at the BLC and the MHC. The results of the survey are presented in Table 3-19 and in Figure 3-19.

3.10.3 Survey Findings

3.10.3.1 South Boston Piers/Fort Point Channel

The South Boston Flats or Piers Area, as this area is sometimes called, was reclaimed from Boston Harbor during the nineteenth and early twentieth century to accommodate docks and warehouses and the transportation systems serving them. Historic resources in this area comprise the Fort Point Channel District, the Commonwealth Pier, and the Fish Pier.

Fort Point Channel District (National Register District-Eligible)

The Fort Point Channel District, located south of Boston's downtown, was developed in the nineteenth and early twentieth century as a wharf and warehousing district served by an integrated system of rail, vehicular, and waterborne transportation. Originally, the Fort Point Channel was a natural channel that skirted the Shawmut Peninsula and led to the South Bay. It was gradually confined by bulkheads as adjacent lands were filled in the nineteenth century. On the filled land to the east of the channel, the Boston Wharf Company (BWC) built blocks of warehouses between 1882 and 1928. Most are four to six stories in height, in a variety of styles of brick construction with flat roofs; openings are trimmed with granite and sandstone. Almost all of the construction undertaken by the BWC was to the design of the company architect, Morton D. Safford and his successor, Howard B. Prescott.

The Fort Point Channel District is considered eligible for listing in the National Register by concurrence of the MHC and the FHWA for the CA/T Project.

TABLE 3-19: HISTORIC RESOURCES IN THE PROJECT AREA

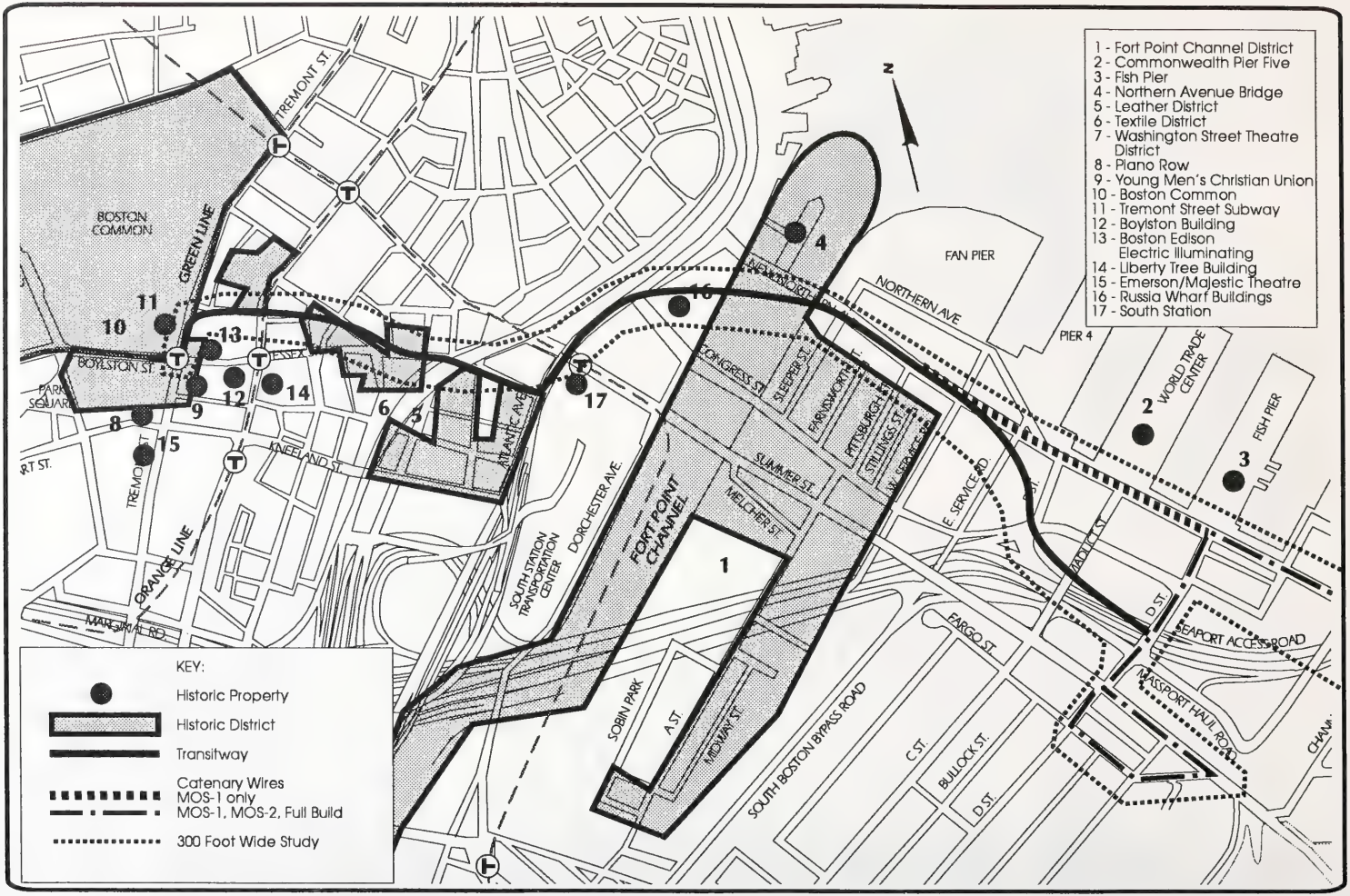
Historic Districts and Properties	Historic Status
South Boston Piers/Fort Point Channel District	
1 Fort Point Channel District	NRD-E
granite bulkheads	
51 Sleeper Street	
44-54 Farnsworth Street	
41-45 Farnsworth Street	
29-54 Farnsworth Street	
42-56 Pittsburgh Street	
41-47 Pittsburgh Street	
51 Pittsburgh Street	
44-48 Stillings Street	
47-49 Stillings Street	
2 Commonwealth Pier Five	NR
3 Fish Pier	NR-E
4 Northern Avenue Bridge *	NR-DOE
Chinatown/Midtown District	
5 Leather District	NRD
Hotel Essex, 687-695 Atlantic Avenue	
705-713 Atlantic Avenue	
Boston Hide and Leather, 20-24 East Street	
66-86 Lincoln Street	
6 Textile District	NRD
Wentworth Building, 90-100 Chauncy Street	
Textile Building, 89-99 Chauncy Street	
Frost Building, 105-111 Chauncy Street	
Chauncy House, 115-117 Chauncy Street	
62-72 Essex Street	
76-78 Essex Street	
73-79 Essex Street	
Pelham Building, 81-83 Essex Street	
Kingston Building, 105-107 Essex Street	
80-86 Kingston Street	
88-100 Kingston Street	
Auchmuty Building, 104-122 Kingston Street	LLp
121-127 Kingston Street	
129-131 Kingston Street	

TABLE 3-19: HISTORIC RESOURCES IN THE PROJECT AREA (continued)

Historic Districts and Properties	Historic Status
7 Washington Street Theatre District	NRD
Paramount Theater, 549-563 Washington Street	LL
Opera House, 537-41 Washington Street*	
8 Piano Row	NRD
Hotel Touraine, 62 Boylston Street	
Little Building, 80 Boylston Street	
Colonial Building/Theater, 96-104 Boylston Street	
177 Tremont Street	
Oliver Ditson Building, 178-179 Tremont Street	
Boston Edison Electric, 180-182 Tremont Street	
Masonic Lodge, 183-186 Tremont Street	
9 Young Men's Christian Union	NR, LL
10 Boston Common	NHL, LL
11 Tremont Street Subway	NHL
Tremont Street Subway	
Boylston Station (underground)	
Boylston Station headhouses	
12 Boylston Building, 2-22 Boylston Street*	NR, LL
13 Boston Edison Electric Illuminating Company, 25-39 Boylston Street*	NR
14 Liberty Tree District	NRD
Liberty Tree Building, 628-36 Washington Street*	LL
15 Emerson/Majestic Theatre, 219-21 Tremont Street*	LL
South Station Area	
16 Russia Wharf Building	NR
17 South Station Headhouse	NR
South Station	NR-DOE

Notes:
- NR: historic property listed in the National Register of Historic Places
- NRD: historic district listed in the NR
- NR-E: eligible for listing in the NR
- NR-DOE: determination of eligibility for listing in the NR
- NHL: National Historic Landmark
- LL: local landmark
- LLp: local landmark, petitioned

* Outside the impact corridor, but of concern to the Massachusetts Historical Commission and Boston Landmarks Commission.



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-19
Historic Resources

Commonwealth Pier Five 165 Northern Avenue (National Register)

Completed in 1914, the original Commonwealth Pier buildings consisted of three two-story sheds which extended the length of the pier, and a flat-roofed headhouse. The buildings have undergone two major alterations, the first to join the three sheds, and the second to create the World Trade Center. The upper level of the headhouse, with its impressive Beaux Arts facade, opens onto a viaduct connecting to Summer Street; the lower level opens at grade to Northern Avenue. Commonwealth Pier Five is significant for its role in the maritime history, economic growth, and transportation development of the Port of Boston.

Fish Pier (National Register-Eligible)

The Fish Pier was constructed between 1910 and 1914 for the Boston Fish Market Association when its lease on "T Wharf," an appendage to Long Wharf, was about to expire. At its completion, the pier was called "the largest and best equipped pier in the world devoted to the Fish Industry" (Stott, 1984).

The Fish Pier is considered eligible for listing in the National Register by concurrence of the MHC and the FHWA for the CA/T Project.

Northern Avenue Bridge (National Register-Determination of Eligibility)

The Northern Avenue bridge, built in 1908, is one of three surviving swing bridges built in the City of Boston in the late nineteenth and early twentieth centuries. It is the only operable bridge of the three.

3.10.3.2 Chinatown/Midtown District

This densely developed section of Boston's downtown between South Station and the Boston Common contains districts of midrise structures built in the late nineteenth and early twentieth century to serve clusters of specialized industries and businesses. Five historic districts and some thirty historic properties are located in this section of downtown Boston.

Leather District (National Register District)

Composed of nine blocks between Chinatown and South Station, the Leather District is an end-of-the-century development of massive five or six-story warehouses serving the leather industry. The Leather District is outstanding as Boston's most intact and homogeneous district of late nineteenth century vernacular commercial structures. The proximity to South Station and earlier railroad terminals also attracted hotels to this area.

Textile District (National Register District)

Located in the southern portion of Boston's central business district, the newly listed Textile District contains late nineteenth and early twentieth century mercantile buildings, in addition to a few light manufacturing structures and one converted apartment building. Buildings within the district are typically five to eight stories in height and built of red or yellow brick with trimmings in cast stone, brownstone, terracotta, and granite. The district has significant historical associates with the area's development as the center of Boston's dry goods industry, notably textile-related businesses, in the late nineteenth and early twentieth century.

Washington Street Theatre District (National Register District)

This district is an intact row of theaters and commercial buildings, built in the early twentieth century on Washington Street between Avery and West Streets. The Paramount (NR Inventory-Nomination Form), built in 1932, was the last of the major theaters in this district and Boston's "first deluxe picture house." Its Moderne facade and virtually intact Art Deco interior by architect Arthur Bowditch made the building architecturally significant as the city's best example of 1930s theater design and Art Deco interior.

Piano Row (National Register District)

Piano Row achieved its greatest significance in the late nineteenth and early twentieth century. As clothing stores expanded into the Washington Street area, the existing piano and organ companies moved their showrooms to the block of Tremont between West and Boylston Streets, earning it the nickname "Piano Row." Around the turn of the century, many showrooms again relocated, and the block of Boylston Street between Tremont and Park Square became the new Piano Row. Several buildings from this important period in Boston's musical history, and the Colonial Theater, are located in this block.

Young Men's Christian Union 48 Boylston Street (National Register)

The YMCU is an L-shaped institutional structure in High Victorian Gothic style. The Union was founded in 1851 by Harvard students as a biblical Christian literature discussion group which later evolved into a fellowship organization. The building, designed by Bradlee and Winslow, is architecturally significant as the most accomplished example of its style remaining in Boston's central business district.

Boylston Building, 2-22 Boylston Street (National Register, Local Landmark)

The Boylston Building, designed by Carl Fehmer, was built in 1887. It is a six-story freestanding sandstone building with Renaissance and Romanesque detailing. The building is an example of the transition from traditional loadbearing masonry to commercial style skeleton-framed construction pioneered by the Chicago School.

Boston Edison Electric Illuminating Company, 25-39 Boylston Street (National Register)

The Boston Edison Building, designed by Winslow and Bigelow, was built in 1906-7, and altered in 1922 by Winslow and Wadsworth. It is an eleven-story building, one of several "palazzo skyscrapers" in downtown Boston, and has a two-story base and a dominant top and cornice.

Liberty Tree Building, 628-36 Washington Street (Local Landmark, in National Register District)

This 1850 four-and-a-half story building at the corner of Washington and Essex Streets is the earliest major commercial building remaining in the Theatre District. It is an architecturally distinctive structure built by David Sears, one of Boston's most prominent citizens. It bears a carved wooden plaque, commemorating the Liberty Tree that stood on this site.

Emerson/Majestic Theatre, 219-21 Tremont Street (Local Landmark)

The Emerson/Majestic Theatre, built in 1903, is a Beaux Arts style two-story theater designed by the nationally-known architect John Galen Howard. Once known as the Saxon Theatre and operated as a movie house for many years, it was bought by Emerson College in 1983 and is being restored as a legitimate theater.

Boston Common (National Historic Landmark)

Boston Common is considered the oldest public park in the country, noted for its historical associations, landscape design, and public sculpture.

Tremont Street Subway (National Historic Landmark)

The Tremont Street Subway runs under the southeasterly side of Boston Common between Park and Boylston Streets. Opened for service in 1897, the subway was the first in the United States. The headhouses at Park Street and Boylston Street Stations were identical, in an attempt at visual unity and unobtrusiveness. The existing headhouses at Boylston Station are two of four original headhouses; the other two were removed circa 1960.

Boylston Street Station (National Historic Landmark)

Boylston Street Station is remarkably intact and has undergone few modifications since its construction. Most changes were the result of upgrading mechanical and electrical systems and graphics modernization programs. The station is historically and architecturally significant since it remains, with minor changes, as the original station of the 1895-1898 Tremont Street Subway. In contrast, all other remaining original stations have been extensively modernized. The station and kiosks have been designated a National Historic Landmark as well as a National Historic Civil Engineering Landmark.

3.10.3.3 South Station Area

The South Station area has few historic buildings, since most were demolished for the construction of the Central Artery in the 1950s and for the Federal Reserve Bank in the 1970s.

Russia Wharf Buildings, 518-540 Atlantic Avenue, 270 Congress Street, 278-290 Congress Street (National Register)

The three linked buildings at the corner of Atlantic Avenue and Congress Streets are Classical Revival style buildings, dating from 1897-98. They are significant as an intact trio of turn-of-the-century commercial/industrial buildings in an otherwise much altered waterfront area.

South Station Headhouse (National Register) and South Station Atlantic Avenue and Summer Street (National Register-Determination of Eligibility)

South Station is a five-story symmetrical brick structure with a dominant curved headhouse in Classical Revival style. The station is significant both for its role in the consolidation of Boston's railroads and for its architecture.

3.11 EXISTING PARKLANDS STANDARDS AND CONDITIONS

3.11.1 Regulations

Parklands, open space, and recreation areas are protected by both Commonwealth of Massachusetts and federal environmental legislation. The most important piece of legislation is Section 4(f) of the Department of Transportation Act of 1966 (49 USC 1653 (f)). Such legislation mandates that significant publicly owned areas, including countryside, parks, and recreation lands, wildlife and water refuges, as well as significant national or state historic sites, or historic sites of local significance be preserved.

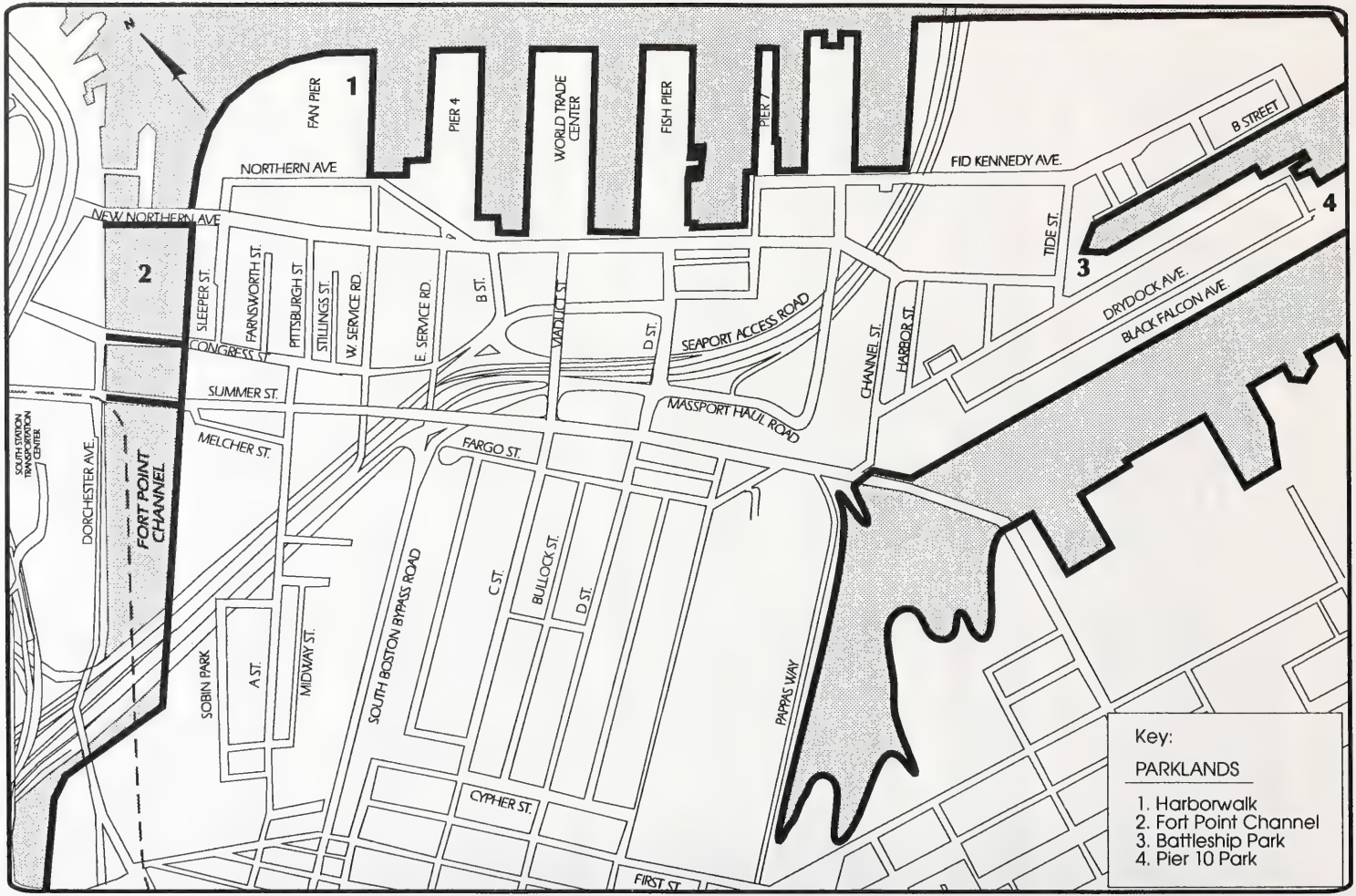
Section 4(f) permits the Secretary of Transportation to approve projects that use these designated sites if two specific determinations are made: (1) there is no prudent and feasible alternative to any federal action that has negative impacts on properties covered by the acts; and (2) all possible planning has been done to minimize harm.

These federal and state environmental regulations call for the assessment of both direct and indirect impacts on parklands and open space. Direct impacts are the physical taking of all or part of a park. Indirect impacts relate to parkland usage and include access to parks as well as alteration of a park's setting. Park usage extends to such passive recreational activities as viewing a park while enroute to another destination. Thus, view corridors to parks become part of the impact analysis.

3.11.2 Existing Parklands

3.11.2.1 South Boston Piers/Fort Point Channel Area

There are very few public parklands within the Piers area, as indicated in Figure 3-20. The most significant open space and recreational resource is Harborwalk, a public/private walkway which borders Boston's



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South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-20
Existing Parklands
In the Piers Area

waterfront. Although portions of Harborwalk are privately owned, the public has waterfront access under Massachusetts General Laws, Chapter 91. When fully developed, Harborwalk will provide a continuous walkway throughout not only the Piers area but other urban areas as well, including downtown Boston. Only a portion of Harborwalk in the Piers area, the waterfront walkway between the Summer and Congress Street bridges, has been developed to date.

A major recreational resource for both the residents of the Piers area and the entire City of Boston is the Fort Point Channel. The principal recreational use of the channel is boating.

Planned parks and plazas in the Piers area include extension of Harborwalk from the Fort Point Channel to the Fish Pier, and the Mariners Park located between Northern Avenue and New Northern Avenue and the East and West Service Roads. Parklands are also planned for the proposed Postal Facility development, although these plans have not yet been formalized. Finally, although they are not parks in the conventional sense, the planned landscaping along the edges and in the medians of New Northern Avenue and New Congress Street will provide greenery to both pedestrians and motorists.

3.11.2.2 Downtown

This area contains very few parklands, as shown in Figure 3-21. Chinatown's parks are small, few in number, and contain minimal recreational equipment. With less than 0.6 acres of open space per 1,000 residents, Chinatown has the least amount of open space for its residents of any neighborhood in the city. Furthermore, because parks are located near heavily traveled roadways, they are difficult to reach, and users are subject to vehicular-related noise and pollution.

On the western edge of the Midtown District is Boston Common, an anchor of Frederick Law Olmstead's "Emerald Necklace" park system. Boston Common has been a green oasis in the city for over three centuries. Since its establishment in 1634, the Common has served as Boston's most popular place for public assembly; central Boston's premier green space since 1837 with the Public Garden as its companion; and a much needed neighborhood park.[8] Other than the Boston Common, there are very few parks in the Midtown District. Unlike Chinatown's parks, they do not contain playground equipment and are not actively used. Rather, they are small passive green spaces.

The South Station area has only two parklands: the Federal Reserve Plaza and a small portion of Harborwalk. Primary users of the Federal Reserve Plaza are office employees who congregate here at lunchtime. The plaza also offers visual relief for pedestrians and vehicle drivers, many of whom cope with severe traffic congestion in this area on a daily basis.

New parkland would be created on the surface of the depressed Central Artery. From Dewey Square to New Northern Avenue, botanical gardens and open space would be created in the median of the surface roadway system. This linear parkland would provide visual relief. In the vicinity of South Station, the parkland would soften the urban environment which is presently dominated by roadways and transportation terminals.

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[8] City of Boston and Boston Parks and Recreation Commission. *Boston Common Management Plan*, December 1990.

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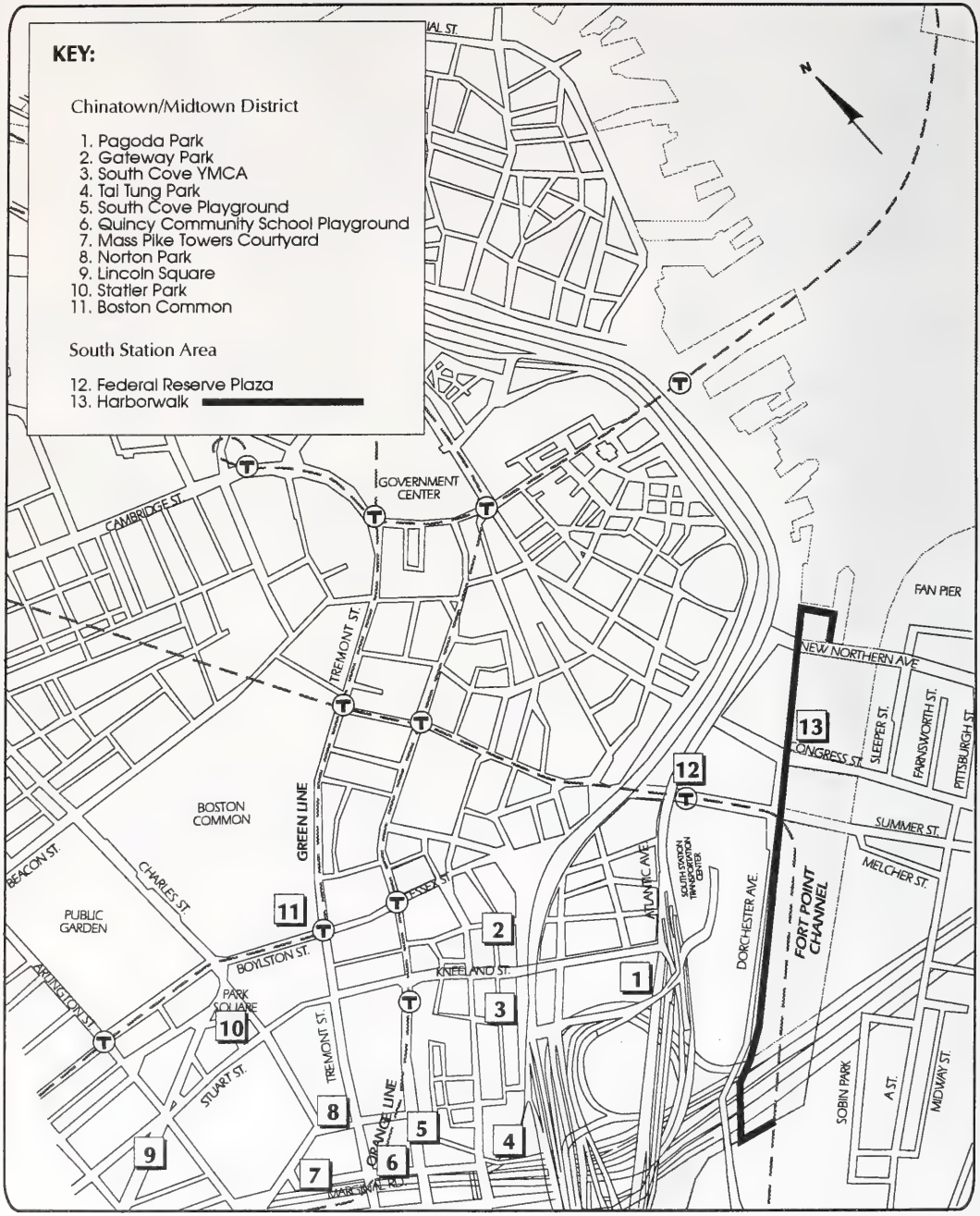
South Boston Piers/ Fort Point Channel Transit Project

Fig. 3-21
Parklands In the Downtown Area



CHAPTER FOUR
Transportation Impacts

CHAPTER 4. TRANSPORTATION IMPACTS

4.1 INTRODUCTION

This chapter summarizes the methodology and results of the transportation impact analysis. Results are presented under four general categories of measures of effectiveness -- Transit Level of Service, Transit Ridership and Mode Share, Transit Productivity, and Traffic Mitigation Impacts. A complete discussion of the methodology and a more detailed analysis of the transportation impacts are presented in *Transportation Impacts Methods and Results Report* (MBTA, October 1992) prepared as part of the DEIS/SDEIR.

In response to comments received on the project's DEIS/SDEIR and earlier DEIR, the chapter also includes a section on water transportation. This section describes the relationship between proposed Transitway service and current and future water transportation services, particularly those under study for the Boston Inner Harbor.

Transportation impacts were estimated for two scenarios -- high and lower growth in the year 2010. The 2010 high growth analysis represents the horizon year and assumes the same level of development as assumed for the CA/T Project. The lower growth scenario assumes more modest increases in development and employment (see Chapter 1, Section 1.2.1).

It should be noted that transit ridership estimates were produced for only four alternatives -- No Action, Bus/TSM, MOS Transitway, and Full Build Transitway. The two MOS Alternatives (MOS-1 and MOS-2), while noticeably different from a design and construction cost standpoint, would be very similar operationally. Because the level of service would be virtually identical for the two MOS Alternatives, a single ridership projection was prepared assuming the MOS-2 alignment. Thus, throughout this chapter, unless otherwise noted, discussion of the MOS Alternatives refers to both MOS-1 and MOS-2.

4.2 METHODOLOGY FOR RIDERSHIP FORECASTING AND TRAFFIC ANALYSIS

The ridership forecasts presented in this chapter were prepared using the most advanced network-based model available for the Boston metropolitan region accompanied by state-of-the-art traffic analysis tools. The ridership model set encompasses the traditional four step process of trip generation, trip distribution, mode choice, and trip assignment. The traffic model was used to assign the resulting automobile traffic to roadways so that individual intersections and roadway elements could be analyzed.

The ridership model, which uses the Urban Transportation Planning System (UTPS) network, is maintained and run by the Central Transportation Planning Staff (CTPS). It was developed and originally calibrated in the 1970s but has been updated and revalidated throughout several subsequent studies. For this project, some further improvements in the model system were made, and the model was again revalidated. The major refinements made for this project included improvements in the representation of the supply of transit service (*i.e.*, transit networks) and in the estimates of the demand for travel (*i.e.*, trip generation and distribution). These refinements and the remaining steps of the ridership forecasting and traffic analysis process are summarized in the following sections.

4.2.1 Ridership Model Refinements

In order to provide the most accurate ridership estimate possible, refinements were made to the model's zone structure and transit network. These included an expansion in the number of zones from 597 to 641

through the disaggregation of several zones in the South Boston Piers area and downtown Boston. A single large zone covering most of the Piers area was divided into 20 zones. To correspond to the disaggregation of the zone structure, transit links were also disaggregated in these areas. Another significant improvement to the network was the addition of a walk network for transit access in the Piers area and in downtown. The entire network was updated to reflect service changes in effect in 1987. Future year networks were created which included improvements expected to occur by the forecast year. Auto access and walk links were also updated to best reflect current and future conditions; parking costs and other relevant transportation supply parameters were similarly updated.

Another refinement involved trip generation and distribution in which the number of travelers between every possible pair of zones for each trip purpose was estimated. Total regional travel demand for the base year was first developed by adapting the total travel demand estimates from a recent study of circumferential transit[1] and incorporating new land use and trip generation information from the CA/T Project. This enabled an allocation of travel to the finer level zone system downtown as described above. The forecast year total travel demand estimates were then developed by modifying the base year estimates using Metropolitan Area Planning Council forecasts of population and employment and allocating the employment among the individual zones using CA/T Project land use and trip generation forecasts.

4.2.2 Mode Choice

The CTPS mode choice model was applied to total base year and forecast year daily travel demand to split trips between the auto and transit modes. The model relates mode choice to the relative difference in peak period travel time and cost between auto and transit, as well as socioeconomic factors. This is done using a series of stratified curves developed from Boston area data in the 1970s. Despite its age and dated model structure, recent studies have shown that the model remains a sound basis for forecasting. Improvements to the mode choice model used in this project consisted only of updated input data. These data included supply parameters, such as travel time and cost information derived from the updated networks, and demand parameters, such as socioeconomic information.

High and lower growth forecast year highway travel times were obtained from year 2010 and year 2000 CA/T Project highway networks, respectively. Base year transit travel times were used for the forecast year except in downtown where some adjustments were made to bus speeds. Forecast year transit fare structures were assumed to be the same as those of the base year. A free transfer was assumed between subway lines and the Underground Transitway. Piers area parking costs for the high growth scenario were set equal to base year costs observed in the heart of central Boston on the expectation that the mix and density of development and the parking policy in the Piers area would be similar to the present situation in central Boston. For the lower growth scenario, Piers area parking costs were estimated by interpolating between high growth scenario costs and the base year on the basis of development forecasts. Base year central Boston parking costs were not changed in many zones in the forecast year but were increased in others based on expectations of future development.

4.2.3 Transit Trip Assignment

The model assigns the resulting daily transit trips to transit routes using an all-or-nothing assignment procedure. According to this assignment procedure, all transit trips between a given origin and destination are assigned to a single minimum time path (based on peak period travel times). Peak hour transit demand was determined through the application of peaking factors to daily transit trips. The peaking factors were purpose-specific and were developed from recent MBTA ridership data. The assignment procedure was used for both base year and forecast year assignments.

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[1] The Circumferential Transit Study base year estimates of total travel were derived from older estimates developed using a gravity model calibrated on actual data in the 1970s.

4.2.4 Base Year Validation and Future Year Forecasting

Before applying the model to forecast future ridership, the model was validated to base year (1987) transit boardings data. Twelve iterations were conducted to refine the model and ensure the most accurate model possible. Once validated, the model was applied to each forecast year scenario for each alternative. In each case, steps were taken to equilibrate transit demand and supply, usually by adjusting headways in the service plan. In the case of the No Action Alternative, however, the constraints imposed by fixed facilities necessitated that bus route capacity be limited and that a manual post-assignment adjustment be made to divert excess transit trips from the overloaded Piers area services. Excess trips were manually reassigned either to the auto mode or to alternate transit paths that would avoid the overcrowded transit services but require a longer walk.

4.2.5 Traffic Analysis Methodology

Automobile person trips resulting from the mode choice model for each growth scenario were converted to vehicle trips and assigned to roadways using a Tranplan network model prepared by the Massachusetts Highway Department (MHD) for the CA/T Project. The resulting traffic and turning movements were analyzed at selected critical intersections using the CINCH analysis software produced by CTPS. This analysis method, which is consistent with the 1985 Highway Capacity Manual, produced level of service and measures of delay at each selected intersection, as well as optimal signal timings and phasings.

4.3 TRANSIT LEVEL OF SERVICE IMPACTS

The level of service provided by each alternative transit improvement is a critical element of the alternative's impact. Transit level of service is not only an indicator of the quality of service experienced by users; it is also a critical factor influencing ridership and mode choice.

There are several components to transit level of service. The most important of these are travel time and cost, although other factors are also of concern when evaluating proposed transit improvements. In the case of the South Boston Piers transit alternatives, travel time, cost, and comfort (as represented by the level of crowding on transit services) are important measures of level of service.

The transit levels of service associated with the project alternatives are described in the following two sections. The first section discusses transit level of service for riders to the Piers area; that is, people who use transit to travel to destinations in the area roughly bounded by the Fort Point Channel, Boston Harbor, and Summer Street. These riders may enter the Piers area on transit or they may walk to the area from a downtown transit station. The second section examines level of service for other affected transit riders who are not traveling to the Piers area.

4.3.1 Piers Area Transit Riders

The project alternatives were designed to provide substantially improved transit service to the Piers area from the entire region. Thus, all of the "action" alternatives (Bus/TSM, MOS, and Full Build) would provide a good level of service from each regional corridor. Nevertheless, there are some differences among alternatives. The travel time from the major radial transit services to Piers area destinations varies among alternatives, but the differences are quite small in comparison with the total travel time from a traveler's origin to a destination in the Piers area. The following sections detail the variation in several level of service measures among the proposed alternatives. The travel times from the major radial services are discussed first, followed by descriptions of total origin to destination travel time, transfers, transit cost, and crowding.

4.3.1.1 Travel Time from Radial Transit Services to the Piers Area

Each action alternative was designed to include good transit service (either Underground Transitway or surface shuttle bus service) from each of the major radial transit lines serving downtown Boston. As a result, the share of the travel market projected to use transit is fairly high in each action alternative, and resulting ridership results do not vary widely. There are, however, distinct advantages to particular alternatives for riders from certain corridors, both in terms of total travel time and the more onerous out-of-vehicle travel time.

To contrast the travel time benefits of the alternatives, travel times from several major radial transit lines[2] to two representative destination zones in the Piers area (Fan Pier and the World Trade Center development between B Street and C Street) were compared among alternatives. As is common practice, a weighting factor of 2.5 was applied to out-of-vehicle time to account for the perceived differences between in-vehicle and out-of-vehicle times. (In other words, each minute of out-of-vehicle time is treated as equivalent to 2.5 minutes of in-vehicle time.) A weighted total travel time was then calculated. The differences in weighted travel time between each alternative and the No Action Alternative are shown in Figure 4-1.[3] Travel time differences are shown for trips to the Fan Pier and the World Trade Center. In the figure, positive values (bars extending upward) indicate travel time savings (*i.e.* minutes shorter than under the No Action Alternative). Negative values (bars extending downward) indicate travel times longer than under the No Action Alternative.

It should be noted that while the No Action Alternative would theoretically provide a better level of service for some trips, it could not possibly accommodate the projected demand. In reality only a few riders would be able to take advantage of No Action services, while the remainder would be forced to walk long distances or choose to drive instead. This fact is not reflected in the figure.

For riders on services radiating to the north (the Orange Line North and the Blue Line), the figure shows improved travel times to the World Trade Center in all action alternatives when compared to the No Action Alternative. There would be no difference in travel time among the action alternatives because riders on these services are projected to use the North Station shuttle bus common to all action alternatives. The shuttle would result in shorter travel times from the north due to slow speeds and less direct service on Route 6 in the No Action Alternative. For trips to the Fan Pier, Orange Line North riders are projected to walk from State Street Station in the No Action Alternative and use the North Station shuttle bus in the action alternatives. The elimination of this long walk produces a significant weighted travel time savings in the action alternatives. Blue Line riders are projected to walk to the Fan Pier from Aquarium Station in all alternatives; thus there are no travel time differences among alternatives from the Blue Line.

More significant travel time differences are projected to occur for riders on transit lines from the west (Green Line West and Orange Line South). The Bus/TSM and MOS Alternatives would provide identical shuttle bus services to the Piers area from these lines. The weighted travel times to both the Fan Pier and World Trade Center using these shuttle services would be longer than the weighted travel times under the No Action Alternative, particularly from the Orange Line South. (The direct service provided by the MBTA Routes 3 and 7 from these lines in the No Action Alternative would not be provided under the action

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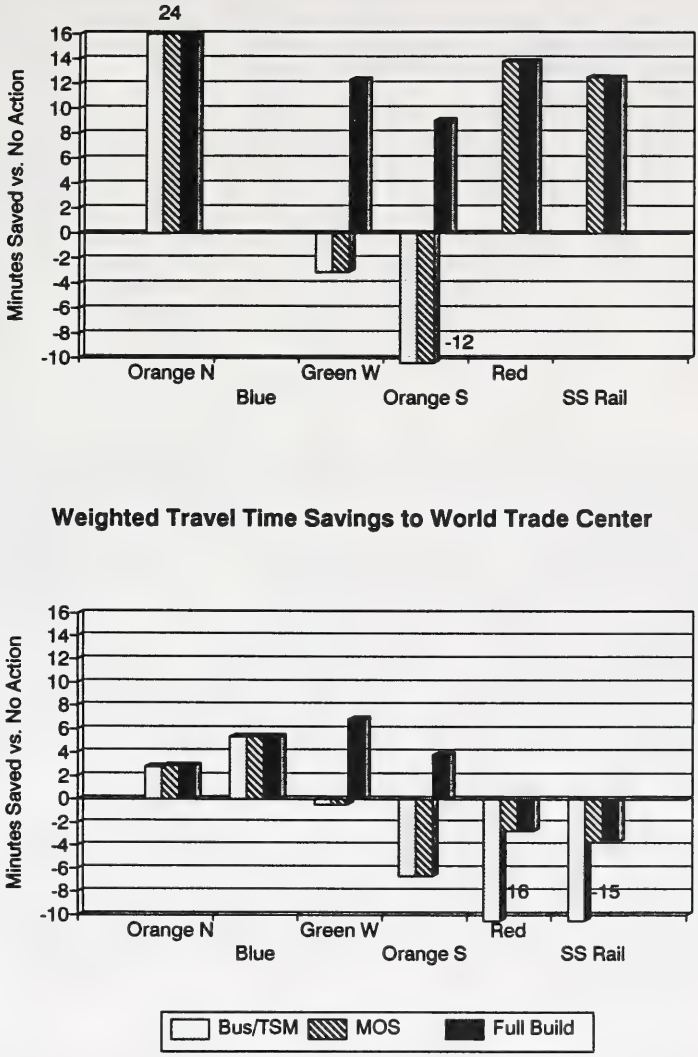
[2] The major radial transit lines are the Orange Line North, Blue Line, Green Line West, Orange Line South, Red Line North and South, and the South Station commuter rail lines. The Green Line North and North Station commuter rail were not included due to their similarity to the Orange Line. Likewise, the South Station express buses are not shown due to their similarity to the South Station commuter rail.

[3] Travel times were calculated only for the high growth scenario. Except for areas served by Piers area express bus services, lower growth scenario travel times would be up to one minute of wait time (2.5 minutes of weighted travel time) lower because less frequent service would be provided.

Fig. 4–1
Weighted Travel Time Differences from Radial Transit Lines versus No Action



alternatives.) The Full Build Alternative would provide the shortest weighted travel time for riders from the west.

For trips from the Red Line and South Station commuter rail to the Fan Pier, No Action and Bus/TSM Alternative travel times would be identical since riders are projected to walk from South Station. The Transitway Alternatives (MOS and Full Build) would provide better weighted travel times. There would be no difference between the MOS and Full Build Alternatives since all riders would board the Transitway at South Station. For trips to the World Trade Center, all of the action alternatives would provide longer weighted travel times than the No Action Alternative due to the very direct service provided by the No Action Route 7. The shuttle buses in the Bus/TSM Alternative would provide the longest weighted travel times, while the Transitway Alternatives would provide weighted travel times shorter than those of the Bus/TSM Alternative, but longer than the No Action Alternative.

In general, for riders from the west (Green Line West) and southwest (Orange Line South), the Full Build Alternative would be the only action alternative with weighted travel times better than the No Action Alternative. For riders from the northwest (Red Line North) and south (Red Line South and South Station commuter rail) corridors, the MOS and Full Build Alternatives would provide equal weighted travel times that are better than the Bus/TSM Alternative but, in some cases, worse than the No Action Alternative. These four corridors would constitute about 75 percent of transit riders to the Piers area. From the remaining corridors (Orange Line North and Blue Line), all of the action alternatives would offer similar travel times that would be equal to or better than No Action Alternative travel times. Finally, it must be kept in mind that the No Action Alternative travel times discussed in this section apply only to those riders who could be accommodated on the capacity-constrained services. Others would be forced to walk long distances.

4.3.1.2 Total Travel Time to the Piers Area

To put the above travel time differences in context, unweighted travel times were calculated from seventeen sample origin zones located throughout the region. The percent difference in total travel time between the Full Build and No Action Alternatives was calculated for each zone for trips to the World Trade Center. Each location was classified according to the percent travel time savings and is shown in Figure 4-2. The smallest savings (under 5 percent) are projected from both near-in and distant areas that have service to South Station. (Unweighted travel times from South Station to the World Trade Center differ very little between the two alternatives.) Only two locations fit into the middle category (6 to 10 percent savings); these are both on the outer ends of the Orange Line where total travel times are longer than from more near-in areas, and thus, the relative changes are smaller. The largest savings (11 percent or more, although most of these are under 15 percent) are clustered in two areas: 1) near-in areas without direct service to South Station (short total travel times make smaller differences relatively large); and 2) outlying areas to the north served by express bus and commuter rail that would have poor connecting service from Haymarket/North Station to the World Trade Center in the No Action Alternative.

4.3.1.3 Transfers Required to Reach the Piers Area

The number of transfers transit riders must make to reach their destinations is an important measure of the perceived quality of the transit service provided that is not captured by travel time measures. However, there is little difference between the alternatives in terms of the number of transfers required to reach the Piers area from any given location. This is because the Piers area transit alternatives are structured to provide only connecting service to the major radial transit lines, rather than direct service from riders' homes.[4] Each alternative introduces a transfer for every rider to the Piers area who cannot walk from a

[4] The exception to this is the express bus service included in the action alternatives for the high growth scenario. In the high growth scenario, some riders will experience fewer transfers by using express buses provided in the action alternatives.

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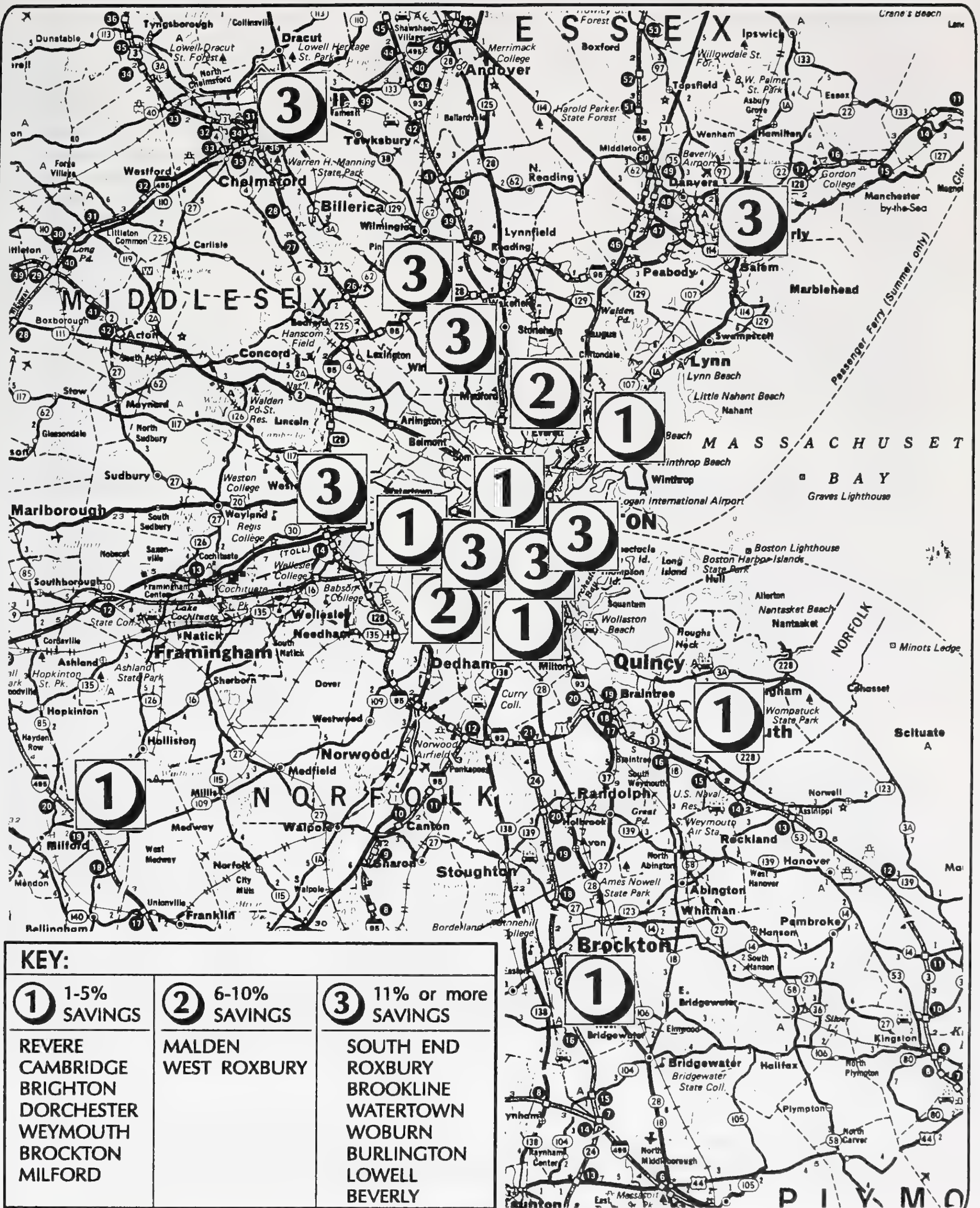
South Boston Piers/ Fort Point Channel Transit Project

Fig. 4–2
Percent Decrease In Travel Time from No Action to Full Build Alternative



radial transit line station downtown. In fact, where the number of transfers does differ among alternatives, fewer transfers usually indicate that a long walk is required to cross the Fort Point Channel as opposed to a transfer to a Piers area transit service. Thus, fewer transfers can actually indicate a poorer level of service.

For trips from all corridors to the World Trade Center, all alternatives require the same number of transfers. For trips to the Fan Pier, there are differences among the alternatives in the number of transfers required for some corridors. Riders from the Orange Line, both north and south, are expected to transfer downtown in all the action alternatives; in the No Action Alternative, they are expected to walk from State Street Station. Riders from the Red Line and South Station commuter rail are expected to transfer to the Transitway in all Transitway Alternatives but are expected to walk from South Station in the No Action and Bus/TSM Alternatives. Transfers for riders from the Green and Blue Lines would not differ by alternative. Green Line West riders are expected to transfer in all alternatives, while Blue Line riders are expected to walk from Aquarium Station in all alternatives.

4.3.1.4 Transit User Cost

Cost is also a major component of transit level of service. For most transit riders to the Piers area, the cost of the line haul portion of their trip would not vary among the alternatives.[5] Any cost differences among alternatives for an entire trip would result from differing fares and transfer policies of the various Piers area services, as well as the extent to which riders choose to walk across the Fort Point Channel. Transit cost was examined for trips from the major radial transit lines to Fan Pier and the World Trade Center.

For trips to Fan Pier, there would be no additional fare beyond the regular line haul fare for riders of the Blue Line, Red Line, and South Station commuter rail in any alternative. This is because Fan Pier lies within relatively easy walking distance of South Station and Aquarium Station, and riders to these stations are not expected to transfer to a Piers area service to reach Fan Pier. For riders passing through North Station (from the Orange, Green, and commuter rail lines), the North Station shuttle bus fare of $0.60 would apply in all of the action alternatives. In the No Action Alternative, the ridership model projects that these riders would walk to the Fan Pier (mostly from State or Government Center Stations) rather than take the circuitous Route 6 (which follows Commercial Street around the North End and makes a stop at South Station). From the Green Line West and Orange Line South, riders would take shuttle buses (in the Bus/TSM and MOS Alternatives) or local buses (Route 7 in the No Action Alternative) and pay a $0.60 fare to reach Fan Pier. In the Full Build Alternative, however, these riders would have a free transfer to the Transitway.

For trips to the World Trade Center, transit users are not projected to walk from the downtown stations on the radial transit lines (with the exception of a very few riders in the No Action Alternative who would not be able to use the overcrowded local bus routes). Thus, from all corridors in the No Action and Bus/TSM Alternatives, riders would pay a $0.60 bus fare to reach the World Trade Center. In the MOS Alternatives, Red Line riders would receive a free transfer, while South Station commuter rail riders would have to pay the $0.85 fare to use the Transitway. The free transfer is extended to Green Line West and Orange Line South riders in the Full Build Alternative.

It should be noted that these costs refer only to the riders who pay cash fares (approximately 57 percent of MBTA riders today). Holders of monthly passes, except the "subway" pass, would receive free transfers to all Piers area surface bus services. For the Transitway Alternatives, commuter rail pass holders would be allowed free entry into the Transitway instead of paying the $0.85 cash fare. Rapid transit riders would also receive a free transfer to the Transitway.

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[5] One exception would be those riders who use Piers area express buses provided in the action alternatives. These express bus services would not be available in the No Action Alternative.

4.3.1.5 Crowding on Piers Area Transit Services

For the action alternatives, the frequency of service on each of the transit routes serving the Piers area was set so that ridership and frequency would be in equilibrium. As a result, average peak hour peak loads would approach, but not exceed, design capacity. Thus, on all services, loads are not projected to exceed the design capacity of 60 passengers for standard buses and 97 passengers for articulated buses.[6] Because of this design decision, it is projected that no overcrowding would occur on Piers area transit services under the action alternatives.

Under the No Action Alternative, the frequency of each local route was set at a level reflecting the maximum amount of service the MBTA could provide using its existing capital facilities. Projected ridership at these frequencies exceeded capacity, but it was assumed that loads on the three local bus routes serving the Piers area could not exceed the design load of an average of 60 passengers per bus. This results in more transit users walking across the Fort Point Channel than would otherwise be the case, and more travelers simply choosing to drive rather than use transit. While it is possible that peak hour average loads could exceed the design load (and approach "crush" load), it was assumed that the long-term result would be a shifting away from usage of these routes and average loads equal to the design load. Thus, peak hour peak loads are assumed to be no higher in the No Action Alternative than in the action alternatives and, therefore, crowding, as a measure of comfort, would be no different. As a result, the impacts of the peak period capacity constraint on transit level of service are identified as increased walk time for some riders rather than increased crowding. Conversely, if increased crowding were to occur, then the amount of walking across the channel would be reduced.

Piers area riders would also experience crowding on the regional transit lines used to reach the Piers area transit services. The impacts of the alternatives on crowding on regional services is discussed below.

4.3.2 Non-Piers Area Transit Riders

While most of this chapter focuses on the impacts of the alternatives on travelers whose destinations lie within the defined boundaries of the Piers area, the alternatives would affect other travelers as well. These impacts fall into three primary categories:

1. Service improvements created by the new services
2. Negative service impacts due to the rerouting of existing services
3. Crowding on regional transit services

4.3.2.1 Service Improvements for Non-Piers Area Transit Users

Travelers with trip origins throughout the region and destinations in the South Boston industrial area south of Summer Street (outside the defined project area) would benefit from improved Piers area transit services. These riders would be affected by the alternatives in much the same way as riders destined to the Piers area. The number of affected riders is discussed in Section 4.4.9. Two other groups of riders, however, would see some improvement in level of service in a different manner: Route 7 riders from residential South Boston making trips to downtown and other destinations, and riders on Piers area services who ride solely on the downtown side of the Fort Point Channel.

Route 7 would follow approximately the same alignment in the No Action, Bus/TSM, and MOS Alternatives, traveling along Congress Street to South Station and ending at Federal and Franklin Streets in the Financial District. There would be little difference in the impacts on non-Piers area Route 7 riders among these alternatives. In the Full Build Alternative, however, Route 7 would enter the Transitway at the D Street portal and serve all underground Transitway stations. Piers area destinations and South Station

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[6] These design capacities reflect consistent standee crowding levels for the two vehicle types.

would continue to be served, and new stops would be added in the Midtown District at Chinatown and Boylston Stations. The current Federal and Franklin Streets stop, however, would be dropped. The headway would also be reduced from 10 to 5 minutes to accommodate increased ridership demand. This would result in a 2.5 minute reduction in wait time for riders between residential South Boston and downtown.

Another group of non-Piers area transit riders who would be affected by the alternatives would be those who use Piers area transit services for trips within downtown Boston (without crossing the Fort Point Channel). The only Piers area services that could provide local service downtown are the North Station shuttle bus (between North and Aquarium Stations) in all alternatives and the Full Build Alternative (between South, Chinatown, and Boylston Stations).

4.3.2.2 Service Impacts on Non-Piers Area Transit Users

Travel on local bus routes that occurs on only those segments that lie outside the Piers area would be almost completely unaffected by the alternatives. In comparison to the No Action Alternative, the only impacts of the action alternatives on riders of these segments would be caused by increased comfort (due to reduced crowding) and elimination of the higher No Action frequencies resulting in longer wait times. The trips served by these segments would remain unaffected. Thus, with the exception of minor frequency reductions, the action alternatives would not have a negative impact on non-Piers area transit riders with one exception. In the Full Build Alternative, Route 7 would no longer serve the stops on and around Federal Street in the Financial District. The improved frequency, however, would almost completely offset the longer walk distances to zones in the northern part of the Financial District. Thus, the shifting of Route 7 into the Transitway, including the corresponding increase in frequency, is not expected to have negative impacts on riders between residential South Boston and the Financial District.

4.3.2.3 Crowding on Regional Transit Services

Because transit riders to the Piers area would use regional transit services to the downtown before boarding Piers area services, crowding impacts on the regional transit services are not expected to vary significantly between alternatives. Figures 4-3 and 4-4 illustrate the 1989 and projected 2010 load factors for the lower and high growth scenarios at the peak load points on all lines. Load factors are expressed as a percentage of effective line capacity. MBTA improvements currently underway or programmed are assumed to be in place in 2010. These include longer trains on the Red, Blue, and Green Lines, more frequent service on the Red and Orange Lines, and operational improvements allowing greater reliability.

Under the No Action Alternative, the Red, Orange and Blue Lines are expected to operate well below capacity, while the Green Line is expected to be over capacity, particularly under the high growth scenario. Under the action alternatives, peak loads on the rapid transit system are not expected to increase significantly in comparison to the No Action Alternative. Red Line peak loads are expected to be highest under the MOS Alternative, since riders with a choice between the Red Line and other lines would tend to use the Red Line due to its direct Transitway connection. Nevertheless, Red Line loads under the MOS Alternatives are not expected to exceed 90 percent of capacity. Orange Line peak loads are expected to be highest under the Full Build Alternative, in which a direct connection is provided to the Transitway; peak loads, however, are expected to remain below 85 percent of capacity. Green Line loads are also expected to be highest under the Full Build Alternative, but the difference among alternatives is less significant in comparison to the general level of overcrowding projected under all alternatives. Clearly, Green Line overcrowding would not be a direct result of the choice of Piers area transit alternative, nor of the development of the Piers area (in contrast to development of other areas of Central Boston).[7] In the high growth scenario, Blue Line loads are actually projected to be less in the action alternatives than in the No

[7] Increasing the capacity of the Green Line and providing alternative services for Green Line riders is the focus of other ongoing studies.

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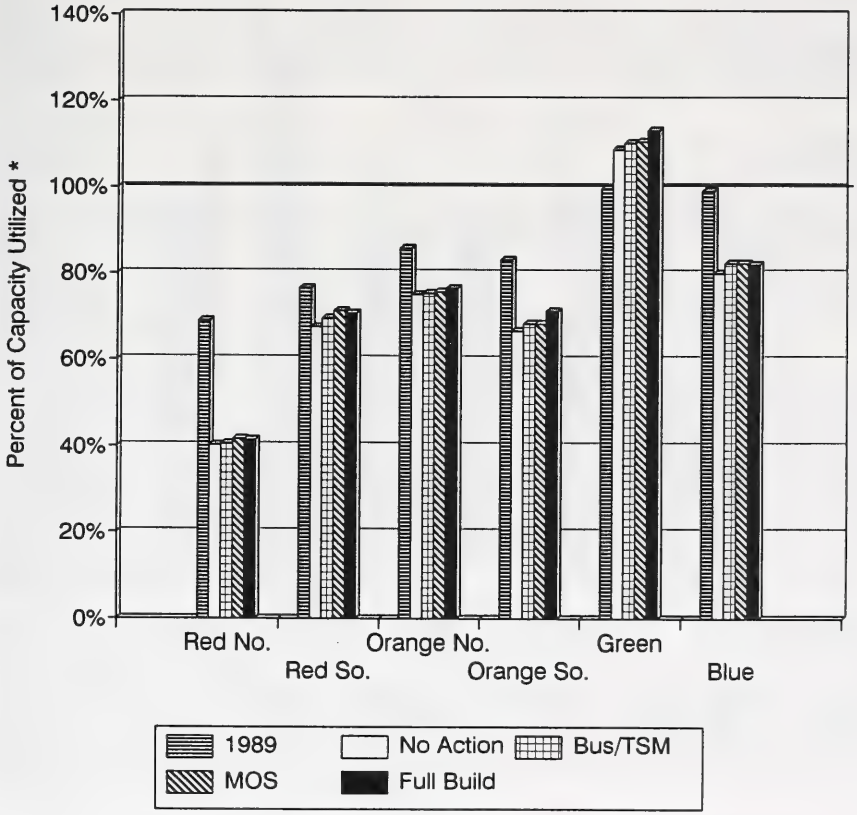
Fig. 4-3
A.M. Peak Hour Loads on Rapid Transit Lines (2010 Lower Growth)

1989 and Year 2010 Lower Growth



* includes capacity increases on all lines between 1989 and 2010

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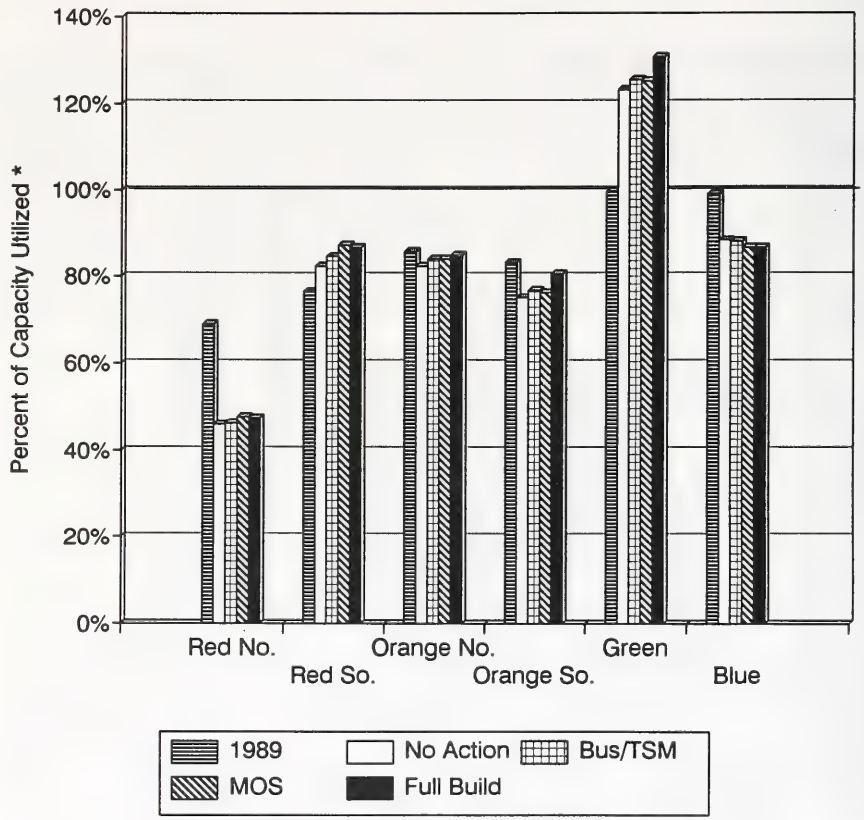
Fig. 4-4
A.M. Peak Hour Loads on Rapid Transit Lines (2010 High Growth)

1989 and Year 2010 High Growth



* includes capacity increases on all lines between 1989 and 2010

Action Alternative, probably due to the Piers area express bus routes from the North Shore included in the action alternatives.

4.4 TRANSIT RIDERSHIP AND MODE SHARE

This section describes the impacts of the alternatives on transit patronage utilizing several measures of interest. These measures fit into two general categories — ridership and mode share. Ridership indicates the overall transit patronage under each project alternative, while mode share describes the relative role played by transit in transporting travelers to an area. For each measure of transit ridership (*e.g.*, peak hour and daily), there is generally a corresponding measure of transit mode share. Typically, both types of measures are of interest when examining a particular aspect of travel behavior.

Several clarifications are necessary regarding the types of trips discussed in this section. First, while the project area for the transit alternatives includes part of downtown Boston in addition to the South Boston Piers area, it is trips with destinations in the Piers area that are the focus of the ridership analyses. Trips destined for the downtown area are already well served by the existing radial transit system and are largely inconsequential to the analysis of the transit alternatives. Therefore, trips with destinations in the downtown portion of the project area are generally not discussed in this section.

Second, with the exception of the discussion of systemwide trips in Section 4.4.1, all of the ridership and mode share data in this section are specified as being either trips that are destined *to the Piers area*, or trips using *new and modified transit services*, regardless of destination. Trips to the Piers area are defined as trips whose destinations are in the area roughly bounded by the Fort Point Channel, Boston Harbor, and Summer Street. These trips are counted as transit trips regardless of whether travelers walk from downtown transit stations into the Piers area or use transit services to enter the area. Trips on new and modified services include all trips that use one of the three existing MBTA routes serving the Piers area or one of the new services included in the transit alternatives, regardless of destination.

Finally, references are made to both a.m. peak hour and daily trips. Unless otherwise stated, these refer to trips in one direction. Daily trips include all trips made in a 24-hour period in one direction only. Because most everyone returns the same day, the number of daily trips in one direction can be assumed to be equal to the number of daily trips in the opposite direction. Therefore, the number of daily trips in one direction is also equal to the number of daily round trips. The number of a.m. peak hour trips is the number of one-way trips in the inbound direction during the morning hour in which the most trips are made. The number of trips in the outbound direction will be less. Peak hour ridership and transit mode share are included as measures of effectiveness since the transit improvements being examined are intended to solve peak hour congestion problems.

In this section, daily regional systemwide linked trips are summarized first, followed by a discussion of a.m. peak hour and daily total transit ridership and mode share to the Piers area. Next, the performance of the alternatives is evaluated by examining transit usage in a number of more detailed ways. These include an examination of travel behavior sub-divided by specific destination within the Piers area, by regional corridor, and by transit sub-mode of entry into the Piers area. These measures can help identify variation among the alternatives that is not detectable in an aggregate sense. Finally, ridership on the new and modified services included in each alternative is presented, followed by estimates of the revenue impacts associated with the ridership forecasts.

4.4.1 Regional Systemwide Linked Trips

Daily regional systemwide linked trips would vary depending upon the alternative implemented. A linked trip is defined as a single transit trip made from a traveler's origin to his or her ultimate destination. A trip is counted only once even though it may involve transferring to a second or third route.

In both the high and lower growth scenarios, daily regional systemwide linked trips would be lowest in the No Action Alternative and highest in the Full Build Alternative as shown below. The incremental increase in such trips among the alternatives reflects the gains in level of service earned by each level of investment in new transit improvements.

TABLE 4-1: DAILY REGIONAL SYSTEMWIDE LINKED TRIPS BY ALTERNATIVE

Alternative	Lower Growth	High Growth
No Action	745,172	829,176
Bus/TSM	751,004	845,647
MOS	756,365	854,152
Full Build	762,878	861,988

4.4.2 Peak Hour Ridership and Mode Share

Based upon anticipated development, it is estimated that 12,200 person trips, using all modes of travel, would be generated *to the Piers area* in the a.m. peak hour in the 2010 lower growth scenario. This figure is estimated to be 18,200 in the 2010 high growth scenario. Under the various action alternatives, transit would attract between 5,300 and 6,600 riders to the Piers area during the a.m. peak hour in the lower growth scenario and between 9,300 and 11,200 in the high growth scenario. Table 4-2 shows the projected a.m. peak hour transit ridership and mode share for each alternative and scenario along with daily and annual ridership projections. These estimates reflect all riders using transit for trips to the Piers area regardless of the actual service (Transitway, local bus, shuttle bus, express bus, or walk) used to enter the Piers area. The lowest ridership of the action alternatives is estimated for the Bus/TSM Alternative, while the highest ridership is estimated for the Full Build Alternative. MOS Alternative ridership estimates fall in between the Bus/TSM and Full Build Alternatives, but are closer to the Full Build estimates.

The No Action Alternative is estimated to attract only 3,100 peak hour trips to the Piers area in the lower growth scenario and 4,300 in the high growth scenario.[8] While the three local bus routes serving the Piers area under the No Action Alternative theoretically have the potential to attract a somewhat higher transit ridership, the demand during the peak hour would be greater than the maximum feasible capacity provided on these routes. It is not possible to increase these frequencies further since the No Action Alternative is constrained by the capacity of the MBTA's existing maintenance facilities. The No Action Alternative peak hour ridership estimates, shown in Table 4-2, were therefore reduced so as not to exceed the capacity of the bus routes serving the Piers area.

[8] Peak hour, peak direction ridership of No Action services is capacity constrained in both scenarios. Differences in transit ridership to the Piers area occur because the figures include all transit users with destinations in the Piers area even if they walk across the channel and do not use one of the constrained bus services. Therefore, the number of these transit users who walk across the channel is unconstrained.

TABLE 4-2: TRANSIT RIDERSHIP AND MODE SHARE INBOUND TO THE PIERS AREA

	A.M. Peak Hour		Daily		Annual
	Transit Trips	Transit Share	Transit Trips	Transit Share	Transit Trips (millions)
Lower Growth Scenario					
No Action	3,100	25%	16,800	25%	5.14
Bus/TSM	5,300	43%	19,300	28%	5.66
MOS	6,200	51%	22,000	33%	6.48
Full Build	6,600	54%	24,400	36%	7.18
High Growth Scenario					
No Action	4,300	23%	21,700	24%	6.83
Bus/TSM	9,300	51%	29,900	33%	8.80
MOS	10,600	59%	34,100	38%	10.02
Full Build	11,200	62%	37,000	41%	10.88

Peak hour transit mode share is also illustrated in Figure 4-5. The Bus/TSM Alternative would achieve the lowest transit mode share of the action alternatives, while the Full Build Alternative would achieve the highest share. Transit mode shares under the action alternatives are projected to be higher under the high growth scenario than under lower growth, largely due to increased traffic congestion and higher parking costs. In both scenarios, the peak hour transit mode share of the MOS Alternatives falls about 3 percentage points below that of the Full Build Alternative, while the Bus/TSM Alternative falls 11 percentage points below the Full Build Alternative. Because the No Action Alternative is capacity-constrained, however, its transit mode share would not increase with increased auto congestion. Instead, the transit mode share of the No Action Alternative would be lower with a higher total number of trips to the Piers area.

4.4.3 Daily Ridership and Mode Share

It is estimated that 67,600 daily person trips would be made into the Piers area in the year 2010 under the lower growth scenario and 90,500 under the high growth scenario. Under the various action alternatives, transit would attract between 16,800 and 24,400 riders per day to the Piers area under the lower growth scenario and between 21,700 and 37,000 under the high growth scenario. The projected daily transit ridership and mode share for each alternative are shown in Table 4-2. The lowest ridership of the action alternatives is estimated for the Bus/TSM Alternative, while the highest ridership is estimated for the Full Build Alternative. Ridership estimates for the MOS Alternatives are slightly more than halfway between the Bus/TSM and Full Build Alternatives. The No Action Alternative is estimated to attract 16,800 daily trips under the lower growth scenario and 21,700 under the high growth scenario. These ridership estimates are adjusted to reflect peak period capacity constraints.

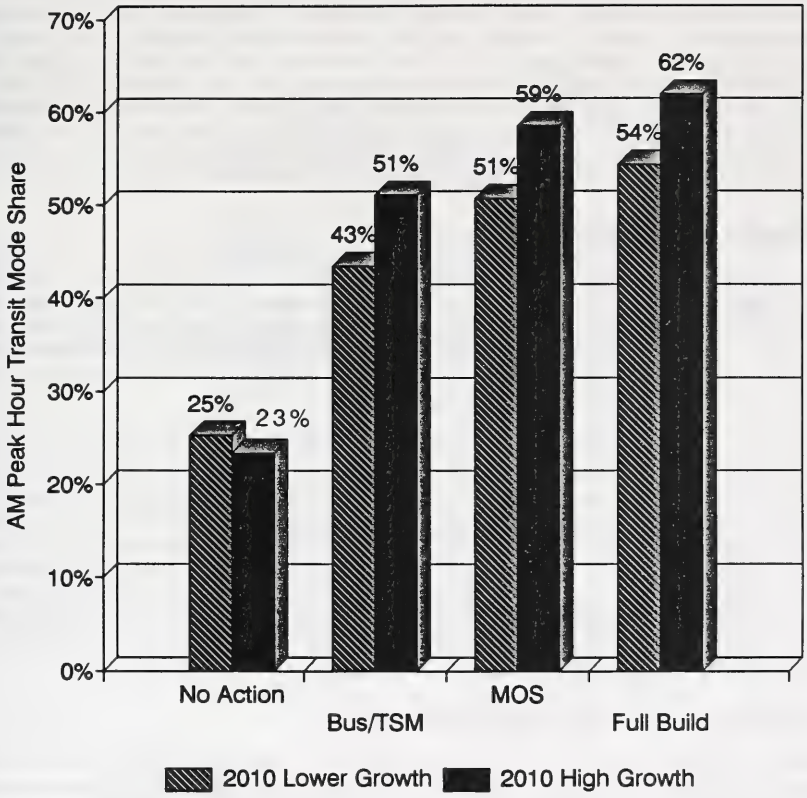
The No Action Alternative would achieve the lowest daily transit mode shares. The Bus/TSM Alternative would achieve the lowest mode share of the action alternatives, while the Full Build Alternative would achieve the highest. Transit mode shares under the action alternatives are projected to be higher under the high growth scenario than under the lower growth scenario. Because the No Action Alternative is capacity-constrained in peak periods, however, its daily transit mode share would not be greater.

The estimated daily transit mode shares to the Piers area achieved by the transit alternatives, ranging from 24 to 41 percent in the high growth scenario, are substantially higher than the estimated current (1987) transit mode share of 18 percent.[9] The projected increases are the result of a combination of factors. First, commuting by auto is expected to become less attractive, the result of both increased traffic congestion and higher parking costs. Constraints on the Piers area parking supply imposed by a parking freeze implemented for the South Boston Piers area (described previously in Chapter 3, Section 3.3.6.2) is expected to produce Piers area parking rates under the high growth scenario that are comparable to those in downtown Boston. Second, improved transit service would make commuting to the area by transit more attractive. These conditions are expected to make travel into the Piers area similar to that into downtown Boston.

Assuming the high growth scenario, the Full Build Alternative would achieve a daily transit mode share for travel to the Piers area that is only 2 percentage points below the projected 2010 transit mode share to downtown Boston (43 percent). In the Bus/TSM Alternative, however, daily transit mode share would fall 10 percentage points below the projected downtown level. The 17 percentage point range between the daily transit mode shares achieved by the alternatives indicates the importance of the level of transit service provided. Even the 8 point range between action alternatives is indicative of the impact of further refinements to the proposed transit service.

[9] The 1987 mode shares are from CTPS model estimates.

Fig. 4–5
A.M. Peak Hour Transit Mode Share to the Piers Area



4.4.4 Annual Ridership

Annual estimates of transit ridership to the Piers area (shown previously in Table 4-2) range between 5.1 and 7.2 million for the lower growth scenario and 6.8 to 10.9 million for the high growth scenario. Consistent with past MBTA research, the estimates are based on expansion of weekday projections assuming 294 weekday equivalents per year.

4.4.5 Ridership and Mode Share by Sub-Area

Transit mode share is projected to vary by location within the Piers area. Contributing to this variation are the distances from CBD transfer points, the distances from bus stops and transit stations in the Piers area, and differences in projected parking costs (*i.e.*, availability). For analysis purposes, the Piers area was divided into sixteen transit study zones; however, results were aggregated into six sub-areas for presentation purposes.[10] In all sub-areas, the Full Build Alternative would attract the highest transit mode share. The highest transit mode shares in the action alternatives would be achieved in the D Street sub-area (which includes the World Trade Center expansion) and in the Fan Pier/McCourt sub-area. The lowest transit mode shares would be in the Boston Wharf area near the Fort Point Channel. Transit mode shares in the Boston Wharf area would vary least among the alternatives, the result of a large number of transit users walking across the channel from nearby South Station. In contrast, transit mode shares to D Street and BMIP would vary the most among the alternatives.

4.4.6 Ridership and Mode Share by Regional Corridor

For purposes of presenting distributions of the origins of trips to the Piers area, the Boston metropolitan area was divided into six regional (radial) corridors, plus central Boston (Boston Proper east of Massachusetts Avenue).[11] The corridors reflect the catchment areas of the major transportation routes in Boston. The South/Southeast Corridor, with the largest area of all the corridors, accounts for about 25 percent of all trips to the Piers area, the most of any corridor. The other six corridors would each produce between 8 and 16 percent of daily trips to the Piers area.

Peak hour transit mode shares for the regional corridors (plus Boston Proper) are graphically displayed in Figures 4-6 and 4-7. The Northeast and North Corridors show little variation among the action alternatives. In contrast, the Northwest and South/Southeast Corridors are projected to produce much higher transit mode shares for the Transitway Alternatives than for the Bus/TSM Alternative. However, because most riders in these corridors would likely access the Transitway at South Station via either the Red Line or South Station commuter rail, the Full Build Alternative shows little improvement over the MOS Alternatives. Transit mode shares from the West and Southwest Corridors vary the most, highlighting the benefits of the Boylston and Chinatown Stations included in the Full Build Alternative. For example, the Southwest Corridor is projected to achieve among the lowest transit mode shares under the Bus/TSM and MOS Alternatives, but the highest transit share under the Full Build Alternative.

4.4.7 Transit Sub-Mode of Entry to the Piers Area

Transit riders may use any of several transit sub-modes to reach their final destination in the Piers area. They may use the Transitway, shuttle, or express bus services that are offered in the action alternatives, use the supplementary local bus services, or walk directly from a regional transit station located across the

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[10] The boundaries of the six sub-areas, as well as sub-area ridership and mode share data, are shown in *Transportation Impacts Methods and Results Report* (MBTA, October 1992). Ridership and mode share data by zone are contained in the appendix to that report.

[11] These corridors, as well as corridor ridership and mode share data, are shown in the *Transportation Impacts Methods and Results Report.*

Fig. 4-6
Peak Hour Transit Share for Piers Area Trips by Corridor (2010 Lower Growth)

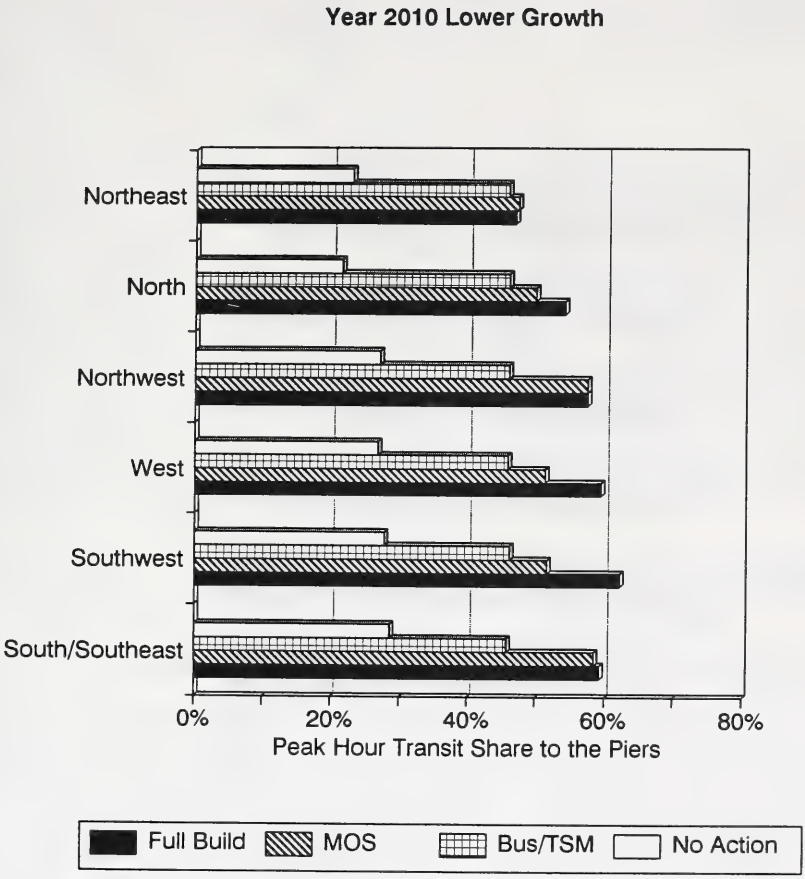

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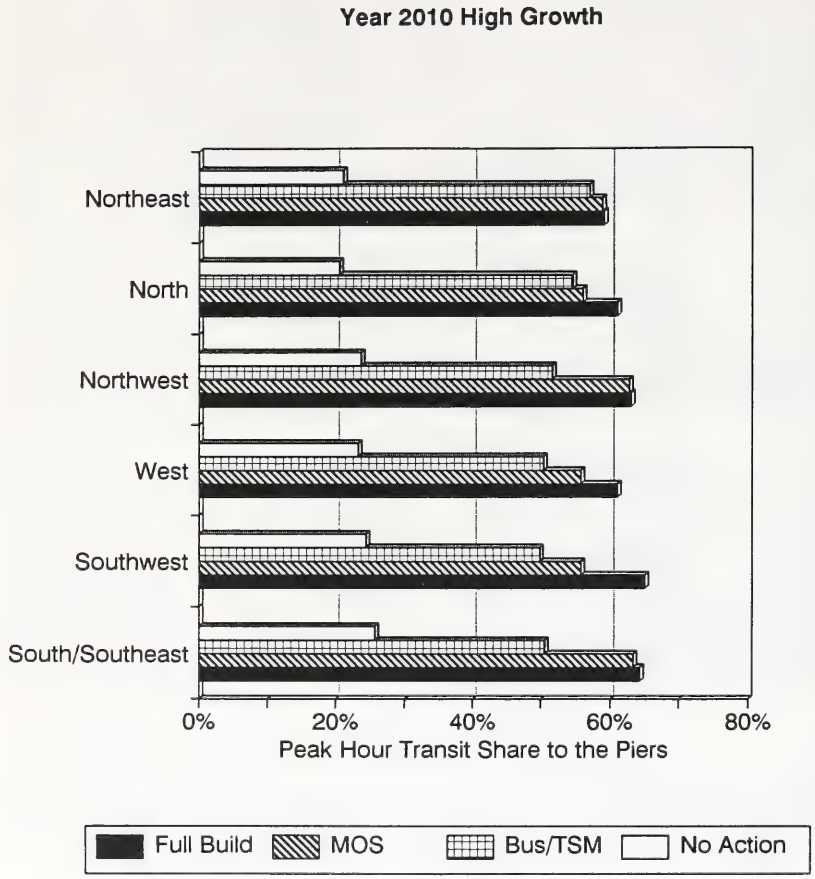
Fig. 4-7
Peak Hour Transit Share for Piers Area Trips by Corridor (2010 High Growth)



Fort Point Channel in downtown Boston (*e.g.*, South Station). The degree to which transit users simply walk from downtown regional transit terminals may reflect a poorer quality of service associated with the alternative's particular bus service components.

Figures 4-8 and 4-9 show the mode and sub-mode of entry for all person trips to the Piers area (including those made by auto) for the high and lower growth scenarios. It is evident that Piers area transit services play a much more significant role in trips to the Piers area in the Transitway Alternatives than they do in the Bus/TSM and No Action Alternatives. This increase in the use of transit services translates into fewer auto trips as well as fewer transit trips that include walking across the channel. The greater role of the Transitway services in the Full Build Alternative, in comparison to the MOS Alternatives, is also quite evident. Thus, the Transitway Alternatives not only reduce auto usage, they also reduce the number of surface buses and provide better service to riders, as evidenced by the significant reduction in riders who walk across the channel to their destinations.

4.4.8 Ridership by Number of Transfers

Each of the alternatives was designed to encourage transfers from downtown radial services. Nevertheless, a substantial number of Piers area trips are still expected to be made without transfers. These are largely trips that involve walking across the Fort Point Channel from South Station, trips from residential South Boston, and, in the action alternatives for the high growth scenario, Piers area express bus trips. Table 4-3 shows transit ridership to the Piers area by number of transfers. The high percentage of daily riders requiring no transfers in the No Action Alternative (which does not provide Piers area express bus services) is clearly a result of the capacity constraint during peak periods which forces transit users to walk from South Station. Thus, in the case of the No Action Alternative, the high percentage of no-transfer trips to the Piers area actually indicates a lower quality of service. The greatest percentage of no-transfer trips is expected under the Bus/TSM Alternative. This is largely the result of higher express bus usage and greater numbers of people walking across the channel. The smallest percentage of no-transfer trips is projected for the Full Build Alternative. This appears to result from riders who, in the Bus/TSM Alternative, would either walk across the channel or use express buses, choosing to transfer to Transitway services in the Full Build Alternative. Since express buses and walking are still available options to riders in the Full Build Alternative, the explicit choice of the Transitway service implies a better level of service despite the additional transfer.

The Bus/TSM Alternative is projected to result in the smallest percentage of trips involving two or more transfers, again the result of more riders walking across the channel. The MOS Alternatives would result in the largest percentage of multiple transfer trips, followed by the Full Build Alternative.

4.4.9 Total Ridership on New and Modified Services

While transit ridership and mode share *to the Piers area* are important in determining impacts on congestion, it is the total ridership levels on the *new and modified transit services* included in each alternative that determine the amount of service required, stop/station activity, productivity, and revenue. As explained in Section 4.4 above, these two measures of transit ridership are different for two reasons. First, new and modified services may attract riders who do not have destinations in the Piers area. These riders are not included in trips *to the Piers area* but are included as riders of *new and modified services.* Second, some transit riders with destinations in the Piers area may walk across the channel and avoid using any of the Piers area transit services. These are included as riders *to the Piers area* but not as riders of *new and modified services.*

Table 4-4 shows the daily total projected ridership on new and modified transit services. Note that the ridership figures here represent total ridership on the routes, *in both directions.* Because they are capacity constrained in peak periods, No Action Alternative services would carry the fewest riders. Bus/TSM Alternative services would carry the next fewest passengers but with more ridership on shuttle buses than in any of the Transitway Alternatives. The Full Build Alternative services would carry the most riders, with

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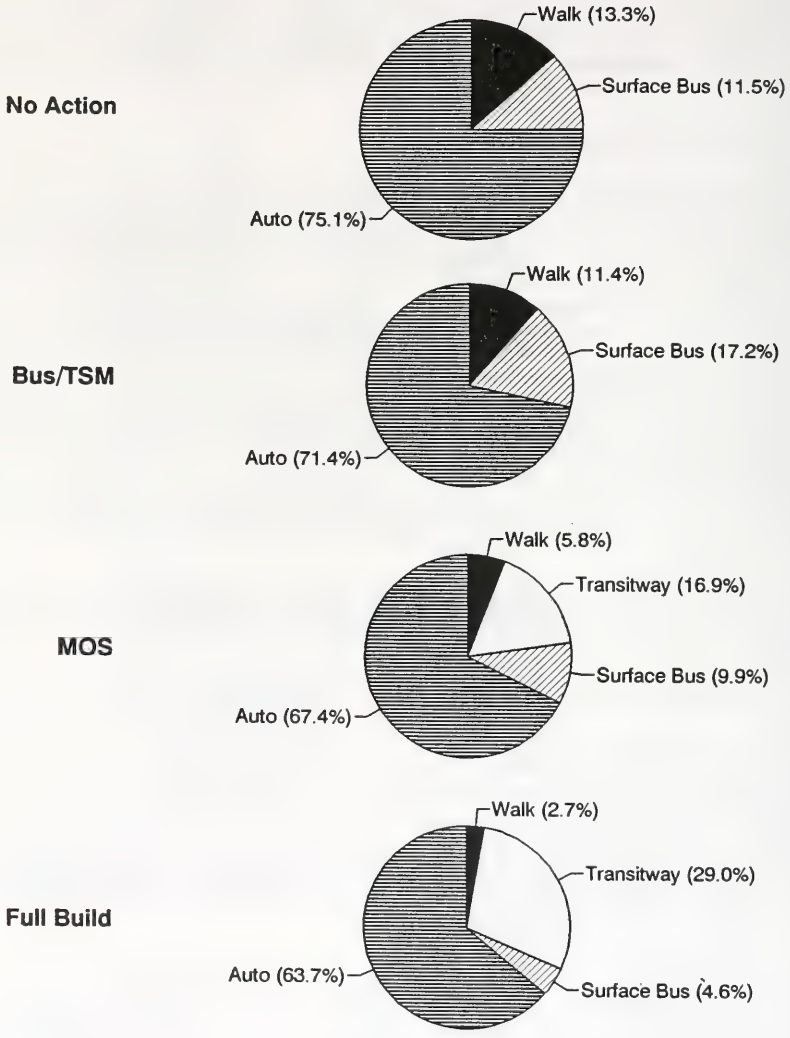
Fig. 4-8
Mode of Entry Into the Piers Area - Daily Trips (2010 Lower Growth)

Year 2010 Lower Growth



Note: percentages may not add to 100% due to rounding

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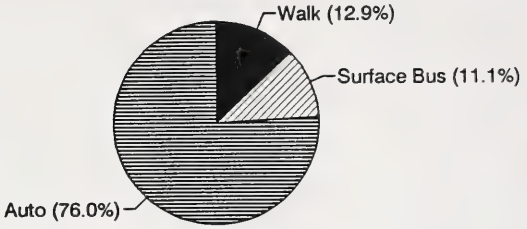
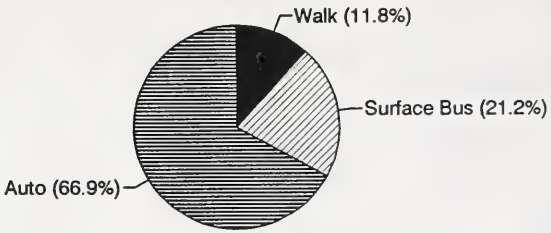
Fig. 4-9
Mode of Entry into the Piers Area - Daily Trips (2010 High Growth)

Year 2010 High Growth

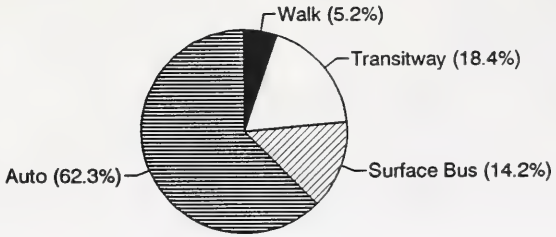
No Action



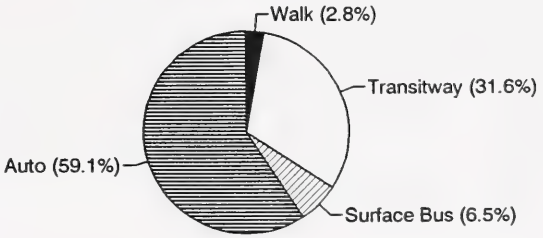
Bus/TSM



MOS



Full Build



Note: percentages may not add to 100% due to rounding

TABLE 4-3: DAILY TRANSIT RIDERSHIP TO THE PIERS AREA BY NUMBER OF TRANSFERS

	No Action	Bus/TSM	MOS	Full Build
Lower Growth Scenario				
Total Ridership to the Piers	16,800	19,300	22,000	24,400
No Transfers	37%	46%	28%	20%
1 Transfer	49%	42%	51%	62%
2 Transfers	14%	11%	20%	17%
3 Transfers	0%	0%	1%	0%
Average Number of Transfers*	0.77	0.65	0.94	0.98
High Growth Scenario				
Total Ridership to the Piers	21,700	29,900	34,100	37,000
No Transfers	40%	47%	31%	24%
1 Transfer	47%	41%	50%	59%
2 Transfers	13%	11%	19%	17%
3 Transfers	0%	0%	1%	0%
Average Number of Transfers*	0.77	0.65	0.89	0.94

* The total number of transfers made daily by riders to the Piers area, divided by the total number of daily riders to the Piers area.

TABLE 4-4: DAILY AND ANNUAL RIDERSHIP ON NEW AND MODIFIED SERVICES

	No Action	Bus/TSM	MOS	Full Build
Lower Growth Scenario				
Local Bus*	21,500	10,700	10,000	6,000
Shuttle Bus	0	18,300	11,600	5,000
Express Bus	0	0	0	0
Transitway**	0	0	24,300	51,600
Total Daily Ridership	21,500	29,000	45,900	62,600
Increase vs. No Action		7,500	24,400	41,100
Annual Ridership (millions)	6.3	8.5	13.5	18.4
High Growth Scenario				
Local Bus*	30,800	13,700	13,100	7,800
Shuttle Bus	0	28,400	17,100	7,100
Express Bus	0	7,500	9,600	8,500
Transitway**	0	0	35,100	70,900
Total Daily Ridership	30,800	49,600	74,900	94,300
Increase vs. No Action		18,800	44,100	63,500
Annual Ridership (millions)	9.1	14.6	22.0	27.7

* Includes MBTA Routes 3, 6, and 7, and the proposed new City Point to Piers area local route in the No Action, Bus/TSM, and MOS Alternatives. Includes MBTA Routes 3 and 6, and the proposed new local route in the Full Build Alternative.

** Includes MBTA Route 7 in the Full Build Alternative.

Note: Trips in both directions are counted in this table.

the majority using the Transitway services (including Route 7). The Full Build Alternative would attract more than three times as many new daily riders as the Bus/TSM Alternative under the high growth scenario, and nearly five times as many under the lower growth scenario.

Figure 4-10 shows a breakdown of ridership on new and modified transit services by destination. In the No Action Alternative, approximately 10,800 riders would use these services to travel to destinations outside the Piers area in the high growth scenario. The number of non-Piers area riders would increase to 16,100 in the MOS Alternatives and to 25,300 in the Full Build Alternative. For the lower growth scenario, 5,900 riders would use No Action services to destinations outside the Pier area. This figure would increase to 9,600 in the MOS Alternatives and 17,400 in the Full Build Alternative. Since none of the No Action Alternative services would be eliminated in any of the Transitway Alternatives (thereby forcing riders to divert to Transitway services), the increases must be entirely the result of improvements in the level of service for non-Piers area riders.

A comparison of the daily total *two-way* ridership on new and modified services in Table 4-4 and the daily *one-way* transit ridership to the Piers area shown previously in Table 4-2 indicates that there would be more riders using the new services under the Full Build and MOS Alternatives than there are transit trips into the Piers area. This difference implies that the transit riders walking from downtown transit stations (not using new services) are out-numbered by the considerable number of transit riders who would use the new services provided by the Transitway Alternatives to reach locations outside the Piers area.

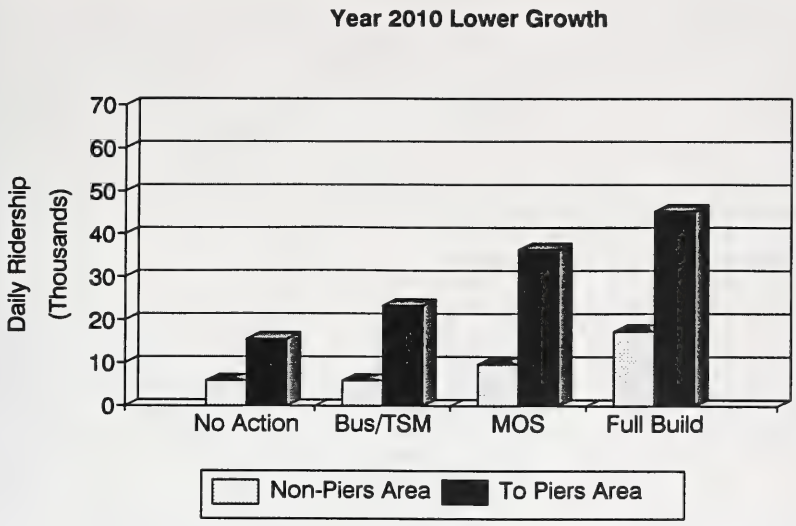
One particular impact on modified services that is worth noting is the impact of the Full Build Alternative on Route 7 ridership. Under the Full Build Alternative, Route 7 would enter the Transitway at the D Street portal and serve all Underground Transitway stations. Piers area destinations and South Station would continue to be served, and new stops would be added in the Midtown District at Chinatown and Boylston Stations. The current stop at Federal and Franklin Streets would be dropped. Peak headways, however, would be reduced from 10 to 5 minutes to accommodate increased demand to the Piers area. The result is projected to be an increase in the number of daily Route 7 riders from residential South Boston (defined here as south of the Reserved Channel) to downtown from about 970 to 1,800 for the high growth scenario.[12] (It should be noted that these are not necessarily new transit trips, just new trips on Route 7.) Under the Full Build Alternative, nearly half of the new Route 7 trips would be destined for the Midtown District (defined here as the area bounded roughly by Tremont, Stuart, Chauncy/Arch, and School Streets), which includes Chinatown and Boylston Stations. Another 30 percent would be destined for the Government Center and North Station areas, most likely transferring from the Transitway to the Orange or Green Lines at Chinatown or Boylston Stations.

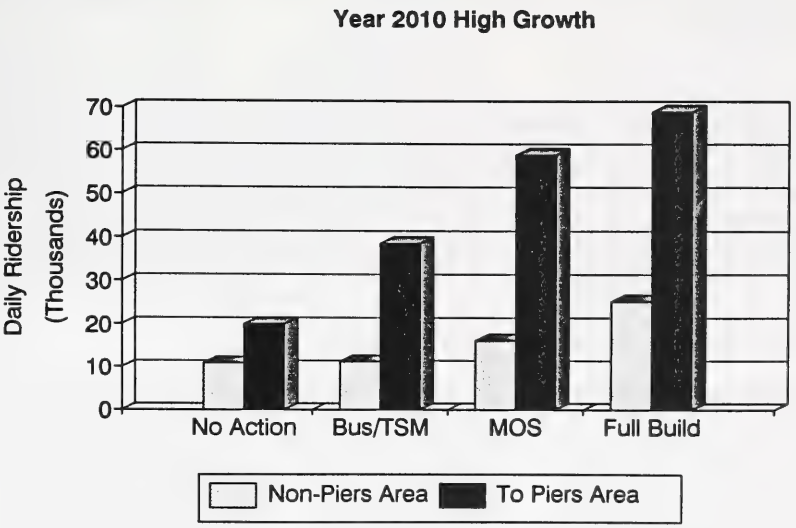
4.4.10 Transitway Ridership

The underground portion of the Full Build Alternative is projected to carry 69,800 daily riders in the high growth scenario. This would result in 71,600 underground passenger-miles of travel. The underground portion in the MOS-1 Alternative would carry 33,900 passengers for 14,800 underground passenger-miles, while the MOS-2 Alternative would carry 34,800 passengers for a total of 26,000 underground passenger-miles. In the lower growth scenario, the Full Build Alternative would carry 51,200 passengers and 51,100 passenger-miles underground. The MOS-1 Alternative would carry 23,700 passengers and 10,200 passenger-miles underground. The MOS-2 Alternative would carry 24,200 passengers and 17,700 passenger-miles underground. Virtually all Transitway riders would cross under the channel to Piers area stations. The only travel projected between downtown stations would occur in the Full Build Alternative where approximately 1,000 daily riders in each direction in each scenario would travel between Boylston and South Stations. The transit paths used for these trips in the other alternatives would still be available in the Full Build Alternative indicating that the Full Build would provide a faster trip and thus an improved level of service for these riders.

[12] These impacts were not calculated for the lower growth scenario.

Fig. 4–10
Destinations of Riders on New and Modified Services





The greatest number of daily downtown boardings for the Full Build Alternative would occur at South Station, although 59 percent of daily downtown boardings would occur either at Boylston or Chinatown Station. In the a.m. peak hour, South Station is expected to account for 50 percent of downtown boardings. While Courthouse Station would serve the highest number of Piers area alightings, over 40 percent of the daily riders crossing under the channel would continue beyond the D Street portal to the surface portion of one of the Transitway routes.

The Transitway would impact the usage of three of the existing downtown rapid transit stations. At Boylston and Chinatown Stations, it is estimated that nearly all of the Transitway boardings would involve transfers from the existing rapid transit system. The total activity on the rapid transit platforms is expected to increase dramatically since the number of transfers between rapid transit and the Transitway at both of these stations far exceeds current station entry counts. At South Station, a smaller percentage of Transitway users are expected to transfer from the Red Line since transfers would also be made from express bus and commuter rail. Nevertheless, the number of riders transferring from the Red Line would add significantly to the Red Line station platform activity, while riders transferring from commuter rail and express bus would add significantly to the volume entering the underground station.

4.4.11 Revenue Implications of the Alternatives

In addition to impacts on MBTA ridership, the project alternatives would have impacts on MBTA revenue. This impact would not be limited to the fares collected from the additional riders attracted by an alternative: several other factors impact revenue. First, the Transitway Alternatives offer free underground transfers from the rapid transit system (consistent with current MBTA policies), while the Bus/TSM and No Action Alternatives, having no underground transfer stations, include no free transfers to Piers area services. As a result, revenue would be reduced in the Transitway Alternatives, partially offsetting the additional revenue resulting from higher ridership. Second, for commuter rail and express bus riders who would not have free transfers to Piers area services, the Transitway fare of $0.85 would be higher than the surface bus fare of $0.60 on Piers area services in the Bus/TSM and No Action Alternatives. This would tend to increase revenue in the Transitway Alternatives. Third, transit users to the Piers area can walk across the Fort Point Channel, avoiding the additional fares on Piers area services. All of this is further complicated by the fact that nearly half of MBTA riders use monthly passes, some of which provide free transfers between rapid transit, commuter rail, and bus services while other pass types do not. It is expected that some riders would chose to buy different passes under different alternatives.

The difference in revenue between the No Action Alternative and each action alternative was projected in consideration of the differences in cash fares, transfer policies, and influences on pass purchase described above. Despite the additional fares gained from the absence of free transfers, the lower ridership and lower fares of the Bus/TSM Alternative would produce the least additional revenue — ***$12.5 million*** more annually than the No Action Alternative in the 2010 high growth scenario, and only ***$4.2 million*** more in the lower growth scenario. The MOS and Full Build Alternatives, despite their different ridership projections and differing availability of free transfers, are projected to produce very similar revenue — ***$14.0 million*** more annually than the No Action Alternative in the 2010 high growth scenario, and ***$5.0 and $5.4 million*** more, respectively, in the lower growth scenario.

4.5 PRODUCTIVITY OF PIERS AREA TRANSIT SERVICES

Transit ridership and mode share are useful measures of the effectiveness of transit alternatives in meeting the transportation goals for the Piers area. Productivity, on the other hand, is an indication of how efficiently resources are being utilized to provide the transit service. While there are many different measures of the productivity of transit service, most measures relate ridership (*e.g.*, total transit boardings) to the amount of resources required to provide the service. The two most commonly used service productivity measures are passengers per vehicle-hour and passengers per vehicle-mile. Each measure compares the usage of a service with the amount of service provided. Vehicle-hours and vehicle-miles are easily calculated for an entire day and for a specific time period. Both measures are closely related to the actual cost of providing transit service.

Figure 4-11 shows the combined productivity of all surface bus and Transitway services for each alternative and scenario. The figure shows that the No Action Alternative would operate with productivities comparable to the Bus/TSM and MOS Alternatives, despite using only standard buses. It should be noted, however, that while the No Action Alternative's productivity is similar to that for the Bus/TSM and MOS Alternatives, its total ridership is much less.[13]

The Bus/TSM Alternative is expected to achieve productivities on a per mile basis that are similar to those for the No Action Alternative. However, due to higher operating speeds on the Seaport Access Road and on dedicated bus lanes, productivities per hour are expected to be greater. Even though the operating plan for the Bus/TSM Alternative would be almost the same in both scenarios, productivity is expected to be higher in the high growth scenario. The reason for this productivity increase is that several of the shuttle routes, which are assumed to operate at a policy headway in both scenarios, are projected to operate well under capacity in the lower growth scenario but closer to capacity in the high growth scenario.

The combined surface and Transitway productivity for the MOS Alternatives is expected to be similar to that for the Bus/TSM Alternative, although it would be higher in the lower growth scenario and lower in the high growth scenario. This is because many riders in the MOS Alternatives would use the high-frequency Transitway where headways would be based on demand. With greater demand in the high growth scenario, service would need to be added. A corresponding increase in vehicle-hours and vehicle-miles would serve to diminish any increased productivity resulting from the ridership increase.

Combined surface and Transitway productivities for the Full Build Alternative are projected to be the highest of all alternatives. This is largely due to the high speed operation of large, heavily-loaded buses in a grade-separated, dedicated right-of-way. The projected productivity of the Full Build Alternative does not vary much between the scenarios. Since most buses are expected to operate at capacity in both scenarios, additional ridership would require a proportional increase in service.

4.6 TRAFFIC MITIGATION IMPACTS

This section presents the results of the traffic analyses performed for the project. Traffic impacts addressed in this section include vehicle-miles-traveled, intersection level of service, and construction impacts.

4.6.1 Change in Vehicle-Miles-Traveled (VMT)

The increase in the use of transit for trips to the Piers area that would result from each of the action alternatives would cause a reduction in the number of auto trips. Consequently, there would also be reductions in daily auto vehicle-miles-traveled (VMT), as shown in Table 4-5. The greatest reduction is projected to occur under the Full Build Alternative where over ***311,428*** daily vehicle-miles in the high growth scenario, and ***169,786*** in the lower growth scenario, could be saved versus the No Action Alternative; this reduction is between ***58,097*** and ***84,120*** vehicle-miles versus the Bus/TSM Alternative. Savings with the MOS Alternatives would be somewhat less. To put these distinctions in context, the VMT reduction brought about by the Full Build Alternative as compared to the Bus/TSM Alternative represents only about ***0.09 percent*** of total regional VMT in the high growth scenario, but ***15 percent*** of VMT for trips destined to the Piers area. Thus, the impact of the alternatives is focused on trips to or from the Piers area.

[13] While peak hour, peak direction ridership on local buses in the No Action Alternative is capacity constrained in both scenarios, ridership in the opposite direction is not constrained. Greater productivity in the reverse direction accounts for the productivity differences between scenarios.

Fig. 4-11
A.M. Peak Hour Productivity on New and Modified Services

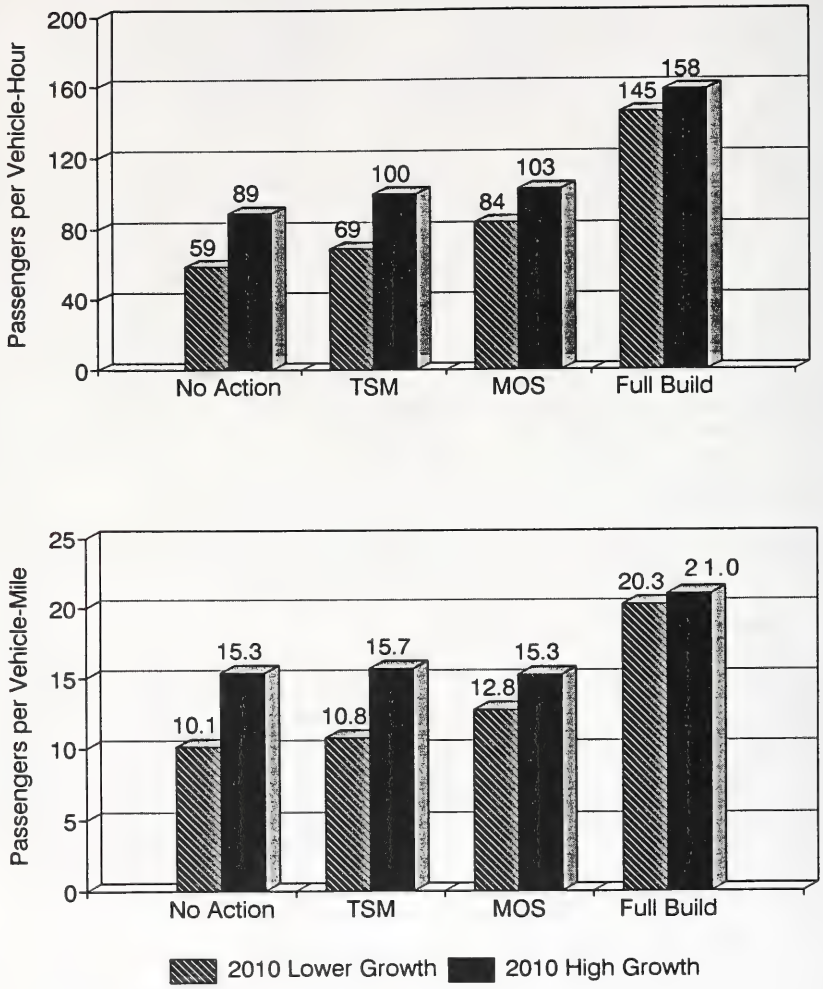


TABLE 4-5: DECREASE IN DAILY AUTOMOBILE TRAVEL

	Automobile Trips Diverted		Decrease in Total VMT	
	versus No Action	versus Bus/TSM	versus No Action	versus Bus/TSM
Lower Growth Scenario				
Bus/TSM	1,800		***116,689***	
MOS	3,800	2,000	***144,786***	***33,097***
Full Build	5,500	3,700	***169,786***	***58,097***
High Growth Scenario				
Bus/TSM	5,900		***227,308***	
MOS	8,900	3,000	***280,036***	***52,728***
Full Build	11,000	5,100	***311,428***	***84,120***

4.6.2 Operational Impacts

The summarized results of the level of service (LOS) analysis for the project are shown in Tables 4-6 and 4-7 for the two scenarios.[14] Analyses were conducted for the p.m. peak at eight intersections in downtown Boston and at seventeen intersections in South Boston. The results of the analyses are expressed in terms of an LOS designation for each location as well as the average intersection delay for each signalized location. ***One*** downtown intersection analyzed — ***Harrison Avenue/Oak Street*** — is presently unsignalized and was treated as such in this analysis; ***the Essex Street/Harrison Avenue intersection was recently signalized***. Traffic conditions for this unsignalized intersection was measured in terms of available reserve capacity.

Since all intersections operate at LOS C or better under all alternatives in the lower growth scenario (see Table 4-6), the following discussion reflects traffic conditions in the high growth scenario only.

In general, the analyses exhibit a trend of improving traffic conditions in progressing from the No Action Alternative up to the Full Build Alternative. The No Action Alternative results in the most severe traffic conditions owing to the increase in development and trip generation in the absence of any significant transit improvements. ***Six*** intersections would operate at LOS E or LOS F under the No Action Alternative in the high growth scenario with a maximum average delay of approximately 89 seconds (LOS F) at the Massport Haul Road/D Street intersection. This intersection consistently exhibits the maximum delay of all signalized intersections for the alternatives under consideration.

[14] The traffic analysis for the lower growth scenario was conducted using year 1998 highway networks.

TABLE 4-6: INTERSECTION ANALYSIS — LOWER GROWTH SCENARIO

	SIGNALIZED INTERSECTIONS									
	Full Build		MOS-2		MOS-1		Bus/TSM		No Action	
INTERSECTION	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Arlington Street/Marginal Road	13.53	B	13.16	B	*13.16	B	13.98	B	13.45	B
Harrison Avenue/Marginal Road	12.89	B	14.07	B	*14.07	B	13.98	B	15.96	C
Essex Street/Washington Street	20.66	C	20.70	C	*20.70	C	20.06	C	22.55	C
Atlantic Avenue/Summer Street	17.93	C	18.31	C	*18.31	C	19.44	C	21.62	C
Atlantic Avenue/New Northern Avenue	20.93	C	21.01	C	*21.01	C	26.09	D	59.48	E
Atlantic Avenue/Congress Street	28.22	D	28.00	D	*28.00	D	31.03	D	36.79	D
Sleeper Street/Congress Street	9.80	B	10.24	B	*10.24	B	10.39	B	12.94	B
Sleeper Street/New Northern Avenue	10.86	B	11.53	B	*11.53	B	12.05	B	34.11	D
Broadway/D Street	23.10	C	23.25	C	*23.25	C	47.33	E	59.69	E
New Congress Street/West Service Road	10.04	B	10.03	B	*10.03	B	9.85	B	10.23	B
New Northern Avenue/West Service Road	9.72	B	9.16	B	10.19	B	9.03	B	8.50	B
New Congress Street/East Service Road	23.16	C	25.50	D	26.44	D	29.15	D	65.44	F
New Northern Avenue/East Service Road	26.69	D	32.17	D	36.62	D	34.56	D	39.89	D
New Congress Street/B Street/Ramp F	13.94	B	15.26	C	15.84	C	13.56	B	13.08	B
B Street/Northern Avenue	10.52	B	11.02	B	12.32	B	10.74	B	13.20	B
C Street/Massport Haul Road	9.14	B	8.34	B	*8.34	B	9.92	B	21.23	C
Summer Street/D Street	25.13	D	28.69	D	*28.69	D	39.65	D	72.41	F
Massport Haul Road/D Street	39.68	D	44.39	E	*44.39	E	66.18	F	88.80	F
Transitway Portal/D Street	4.13	A	3.64	A	--	--	--	--	--	--
D Street / New Congress Street	10.07	B	15.19	C	17.90	C	16.53	C	45.94	E
Northern Avenue/D Street	13.88	B	16.08	C	10.64	B	10.54	B	21.22	C
Fargo Street/Summer Street	3.86	A	3.83	A	*3.83	A	4.76	A	2.47	A
Northern Avenue/Massport Haul Road	5.38	B	4.95	A	*4.95	A	4.96	A	5.79	B
Essex Street/Harrison Avenue	9.99	B	9.95	B	*9.95	B	9.98	B	10.59	B
	UNSIGNALIZED INTERSECTIONS									
	Full Build		MOS-2		MOS-1		Bus/TSM		No Action	
INTERSECTION	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Harrison Avenue/Oak Street	NA	C	NA	D	NA	D	NA	C	NA	D

* No changes between MOS-1 and MOS-2
NA = Not applicable

TABLE 4-7: INTERSECTION ANALYSIS — HIGH GROWTH SCENARIO

	SIGNALIZED INTERSECTIONS									
	Full Build		MOS-2		MOS-1		Bus/TSM		No Action	
INTERSECTION	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Arlington Street/Marginal Road	11.32	B	11.51	B	*11.51	B	11.44	B	11.12	B
Harrison Avenue/Marginal Road	10.29	B	10.87	B	*10.87	B	11.11	B	11.27	B
Essex Street/Washington Street	16.13	C	16.14	C	*16.14	C	16.91	C	16.45	C
Atlantic Avenue/Summer Street	15.94	C	16.43	C	*16.43	C	16.27	C	18.03	C
Atlantic Avenue/New Northern Avenue	13.12	B	13.77	B	*13.77	B	14.19	B	16.44	C
Atlantic Avenue/Congress Street	23.13	C	23.58	C	*23.58	C	23.43	C	22.86	C
Sleeper Street/Congress Street	6.69	B	7.43	B	*7.43	B	7.80	B	8.67	B
Sleeper Street/New Northern Avenue	9.38	B	10.05	B	*10.05	B	10.67	B	11.76	B
Broadway/D Street	12.33	B	18.93	C	*18.93	C	14.39	B	17.45	C
New Congress Street/West Service Road	8.32	B	8.39	B	*8.39	B	8.39	B	8.48	B
New Northern Avenue/West Service Road	6.97	B	7.18	B	7.17	B	7.10	B	7.38	B
New Congress Street/East Service Road	14.34	B	15.66	C	15.98	C	16.55	C	18.81	C
New Northern Avenue/East Service Road	14.29	B	15.71	C	15.77	C	17.33	C	19.47	C
New Congress Street/B Street/Ramp F	12.37	B	12.65	B	12.79	B	12.15	B	16.31	C
B Street/Northern Avenue	8.45	B	8.63	B	8.55	B	9.06	B	8.45	B
C Street/Massport Haul Road	10.95	B	9.41	B	*9.41	B	9.30	B	12.44	B
Summer Street/D Street	18.28	C	18.88	C	*18.88	C	23.61	C	22.12	C
Massport Haul Road/D Street	14.11	B	18.60	C	*18.60	C	18.33	C	18.38	C
Transitway Portal/D Street	3.72	A	2.86	A	--	--	--	--	--	--
D Street / New Congress Street	5.95	B	5.74	B	5.77	B	5.88	B	7.62	B
Northern Avenue/D Street	8.56	B	8.50	B	6.91	B	7.45	B	10.71	B
Fargo Street/Summer Street	2.43	A	2.35	A	*2.35	A	2.74	A	3.02	A
Northern Avenue/Massport Haul Road	5.01	B	5.22	B	*5.22	B	5.05	B	4.32	A
Essex Street/Harrison Avenue	8.90	B	7.68	B	*7.68	B	9.10	B	9.06	B
	UNSIGNALIZED INTERSECTION									
	Full Build		MOS-2		MOS-1		Bus/TSM		No Action	
INTERSECTION	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Harrison Avenue/Oak Street	NA	A	NA	A	NA	A	NA	A	NA	B

* No changes between MOS-1 and MOS-2
NA = Not Applicable

Although the Bus/TSM Alternative introduces a significant transit component to the project area, its operation involves a substantial increase in bus volumes on surface streets. ***Two*** intersections would still perform at LOS E or LOS F under this alternative in the high growth scenario with an average delay of nearly 66 seconds at the Massport Haul Road/D Street intersection. A mitigating factor for the Bus/TSM Alternative is the use of an exclusive bus lane westbound along New Congress Street between West Service Road and D Street.

The MOS Alternatives provide a more substantial transit operation in the Piers area and reduce surface bus volumes by virtue of the tunnel right-of-way. Only ***one*** intersection would operate at LOS E or LOS F in the high growth scenario, and one in the lower growth scenario. The Massport Haul Road/D Street intersection exhibits a delay averaging 44 seconds due in part to the presence of surface shuttle buses which operate to the Back Bay and New England Medical Center areas. No permanent bus lane is proposed as a mitigating action since the opportunity exists to further extend the Transitway to a Full Build configuration. This opportunity would reduce the on-street bus volumes, particularly in terms of the New England Medical Center and Back Bay shuttles. Given such a possibility, it is not warranted to provide an interim bus lane with its permanent land-taking impacts.

The intersection analyses yielded little difference between the MOS-1 and MOS-2 Alternatives. The main operational difference is the shorter tunnel length for MOS-1 with a portal in the vicinity of Pittsburgh Street on New Northern Avenue. The resultant increase in surface bus volumes on New Northern Avenue (as compared to MOS-2) did not significantly affect the performance of the intersections analyzed. However, the introduction of these additional bus volumes does pose concerns for more subjective issues such as community perception and aesthetics.

The Full Build Alternative, by routing additional bus services into the tunnel and eliminating the New England Medical Center and Back Bay shuttles, would result in all intersections performing at LOS D or better. Otherwise, the maximum delay for the high growth scenario (LOS D - 40 seconds) would occur at the Massport Haul Road/D Street intersection. This represents a nearly 55 percent reduction in average delay over the No Action Alternative at this intersection.

4.6.3 Construction Impacts

The project alternatives would be constructed in concert with other major projects along the alignment including the CA/T Project. As such, the Piers area transit project is intended to coordinate any temporary detours with these concurrent activities. ***For example, construction of Transitway elements with the northbound Central Artery as part of the CA/T Project's construction contract C11A1 will involve work in Dewey Square. A maintenance of traffic plan is currently under development by the C11A1 section designer in conjunction with BTD. This plan is discussed in greater detail in Chapter 5, Section 5.13.***

Construction at Boylston Street Station as part of the Full Build Alternative would require excavation within the four lanes of Tremont Street in order to restrict construction activity on Boston Common. This activity would result in the alternating closure of two lanes on the west and east sides of Tremont Street between Avery Street and a point approximately 150 feet north of the Tremont/Boylston Street intersection. It is proposed to provide three-lane capacity during construction by locating a temporary detour lane on Lafayette Mall along the eastern edge of the Common adjacent to the construction zone. The City of Boston has confirmed the adequacy of this proposed three lane configuration based on information furnished by the MBTA.

Maintenance of vehicular and pedestrian access during construction will be the responsibility of the section designer for each Transitway construction contract. Additional details on traffic mitigation for the locally preferred alternative are provided in Chapter 5, Section 5.13 (Mitigation for the Locally Preferred Alternative).

4.7 WATER TRANSPORTATION

The DEIS/SDEIR and earlier DEIR studied a wide variety of transportation options for serving the Piers area. These options focused on the best way to provide transit service to the majority of Piers area riders. From locations where high quality fixed guideway services would not be available, the alternatives assumed that supplemental transit service, in the form of shuttle bus routes, would be available. Water transportation services were not included in the alternatives. Comments received on the DEIS/SDEIR and DEIR asked that the role of water transportation be addressed in the FEIS/FEIR. Most of these comments suggested a role for water transportation in transporting passengers to and from Piers study area developments as part of the supplemental transit service. Other comments suggested that the proposed Transitway be integrated with any future water transportation services, presumably to provide increased accessibility to water transportation from locations served by the Transitway. This section summarizes current and proposed future water transportation services and addresses each of the two general comments.

4.7.1 Current and Future Water Transportation Services

The location of Boston's downtown business district close to Boston Harbor provides Boston with unique water transportation opportunities. In recent years, new water transportation services have taken advantage of these opportunities and attracted new public transportation markets among commuters from the South Shore and in the inner harbor. Massport and MHD have taken lead roles in conducting additional studies of water transportation opportunities in the inner and outer harbor.

Currently, local waterborne passenger service consists of commuter and airport ground transportation as well as tourist/recreational services. Commuter water ferry service is provided from Hingham and Charlestown by the MBTA through contracts with private ferry carriers. The Hingham service transports commuters from Hingham Dock to Rowes Wharf. The Charlestown service transports commuters between Charlestown Navy Yard Pier 4 and Long Wharf Landing. Both services operate at 15 minute intervals in the peak hours, and only the Charlestown service operates on weekends. The Hingham service has a 35 minute scheduled time while the Charlestown to Long Wharf trip is scheduled to take only 10 minutes. In 1992, 1,830 riders used the Hingham service on an average day, and 489 riders used the Charlestown service. Subsidies by the MBTA amount to $5.60 per rider for the Hingham service which charges a fare of $4, and $0.99 per rider for the Charlestown service which charges a $1.00 fare and is supported by the Central Artery North Area (CANA) project. Massport provides airport water shuttle service between Logan Airport and Rowes Wharf. This service operates at premium fares.

While the South Boston Piers area includes a cruise ship terminal in the Reserved Channel, and Commonwealth Pier at the World Trade Center is used for summer service to Cape Cod, the area is not currently served by waterborne commuter or airport access services. The potential for water transportation services to the South Boston waterfront was recognized in several prior studies and is still under investigation.

In recent years, Massport conducted a two-phase study of potential passenger ferry service. The first phase completed in June 1988 focused largely on outer harbor services, but also identified conceptual inner harbor services. The conclusions of that study can be summarized as follows:

- *A significant and growing South Shore market exists for ferry service to downtown Boston and Logan Airport; to maximize cost-effectiveness, additional service from the South Shore to the airport should be integrated with existing service to downtown/*
- *Passenger service to the North Shore does not appear to warrant a public subsidy due to open sea operational problems and competitive ground transit service.*

- *Passenger service to the I-93 North Corridor (e.g., Sullivan Square area) does not appear to be economically feasible due to the high costs associated with docks and parking facilities.*

- *An inner harbor ferry system could include services between any of several terminals: Charlestown Navy Yard, Long/Central/Rowes Wharves, Logan Airport, North Station (i.e., Lovejoy Wharf), and South Boston (Fan Pier, Pier 4, or Commonwealth Pier).*

In 1989, Massport conducted the second phase of the study focusing on the inner harbor. The study began with a list of 35 possible ferry terminal sites, screened the list to 23 sites, and proceeded to analyze the market potential for regularly scheduled and on-demand water taxi service. The study identified potential inner harbor ferry systems for 1995 and 2010 and conducted a detailed analysis of ridership, costs, and revenues.

The 1995 network consisted of several services among the following locations: Logan Airport, Rowes Wharf, North Station, Charlestown Navy Yard, Russia Wharf, Long/Central Wharf, and the World Trade Center (at Commonwealth Pier in South Boston). Service to the World Trade Center was envisioned from North Station in the peak hours operating at a 12.5-minute headway. In off peak hours, the World Trade Center would be part of a triangular route serving the Navy Yard and Long/Central Wharf. In 2010, it was envisioned that the Fan Pier would be added to these two routes as an intermediate stop which would result in a longer headway (15 minutes). Each site in South Boston would require a new terminal and would be expected to serve anticipated development projects at each location. All inner harbor services except for the airport water shuttle would require operating subsidies.

MHD, in cooperation with Massport, has initiated a new study of inner harbor water transportation to update and expand the prior two studies. The first phase of this new study will update the phasing of market demand, reevaluate sites, revise the network plan, and identify new terminal locations. Among the key issues for the study is the identification of existing and proposed markets to and from the South Boston Piers and North Station areas. The study will examine at least two additional sites for docks in the Fort Point Channel area, perhaps at the Northern Avenue bridge and in the vicinity of Museum Wharf. The second phase of the study is expected to provide a more detailed assessment of network operations and terminal designs; this phase will also include an assessment of off-peak recreational services. In addition, the study will consider integration of the proposed ferry service with the Transitway. The results of this new study were not available in time to be incorporated in this FEIS/FEIR. Thus, the following discussion of water transportation issues must rely on older and perhaps out-of-date information about the likely water transportation network.

4.7.2 Additional Water Transportation Service to the Piers

The transit service plans presented in this document did not explicitly consider the role of water transportation in serving Piers area travel demand. While water transportation could not replace the Transitway as the primary service to the Piers area, it could play a role as part of the supplemental transit service needed from areas not directly served by the Transitway. Supplemental water transportation service to the Piers area would need to be justified based on demand to the developments in the Piers study area and a comparison of water services to the supplemental surface bus services included in the Full Build and MOS Transitway Alternatives. If water transportation were to play a significant role, it might reduce the need for some supplementary surface bus service, or even a small part of the service in the Transitway itself.

Both the Fan Pier (Courthouse) and the World Trade Center are proposed Transitway stations as well as dock sites. No specific site for the Fan Pier dock was identified in the 1989 study since development plans were then unclear, but it was suggested that the dock be as close to Northern Avenue as possible to increase the catchment area and as far away from the World Trade Center

as possible to reduce redundancy. Since then, the Federal Courthouse FEIS was issued; it did not identify a specific dock location as part of its development plan, but referred to ongoing GSA and MBTA study of water shuttle possibilities to the site and commits to providing "the most public water transportation that is practicable." Among the possibilities included in the FEIS are inner harbor water taxi, Logan Airport employee shuttle service, and an alternative downtown dock for Hingham commuter service. The new study by MHD should resolve potential dock site issues.

Given the conclusions of the 1989 Massport Water Transportation Study which examined market potential and economics, it is unlikely that direct water transportation services to the Piers area would be provided from remote locations on the South or North Shores. The water transportation services with potential to serve the site are limited to inner harbor services. Based on the 1989 study's envisioned 1995 and 2010 networks, the service of most direct relevance to the Piers area is the North Station to World Trade Center Water shuttle, with a possible intermediate stop at the Fan Pier/Courthouse site. Note that these networks also included off-peak service to World Trade Center and Fan Pier from the Charlestown Navy Yard and Long/Central Wharf. In peak hours, service from Charlestown would be provided to Russia Wharf (on the west side of the Fort Point Channel).

As noted in the DEIS/SDEIR and DEIR, North Station is an important gateway for regional commuters to the Piers study area because it is a commuter rail, rapid transit, and possible future commuter bus hub. As a result, a frequent shuttle bus service between North Station and the Piers area was included in all alternatives, including the locally preferred Full Build Alternative for the Transitway and the two MOS Alternatives (one of which, MOS-2, would comprise the first implementation phase of the Full Build Transitway). A water shuttle from North Station (Lovejoy Wharf) to either Fan Pier or the World Trade Center could provide service competitive with the proposed shuttle bus service for some specific market segments within walk distance of the dock sites.

The North Station shuttle bus route proposed as part of the Full Build Alternative would operate every 5 minutes during peak hours. It would serve North Station, Haymarket Station, Aquarium Station, and Northern Avenue as far as D Street, where it would turn south and return westward along Congress Street. A local bus (Route 6) would operate every 7.5 minutes between North Station and BMIP via the North End, Aquarium Station, and Summer Street. Travelers on the shuttle bus may be better candidates for water shuttle service since the likely dock site at the World Trade Center could not directly serve the BMIP and Summer Street destinations served by Route 6.

There are some advantages that the proposed shuttle bus service would have over the proposed water shuttle. The shuttle bus could serve the Haymarket bus terminal which could not be served by ferry. (Even if this bus terminal is shifted to the proposed Canal Street bus terminal, the shuttle bus would provide a more convenient transfer than the ferry.) The shuttle bus can serve Aquarium Station with less impact on travel time than the water ferry service which would require an additional time-consuming stop at Long/Central Wharf. In the Piers area, the bus has a better distribution system than a single dock. The dock would be a substantial walk from Congress and Summer Streets and from BMIP, while the shuttle (and local) bus would serve these locations directly. Congress Street, in particular, is viewed as the spine of Financial District expansion into the Piers area by the BRA in its Fort Point Channel District Plan. Nevertheless, some specific markets may be able to be served better by water transportation, and some riders may simply prefer ferry service to bus service.

According to development estimates prepared by the CA/T Project for the Piers area, the largest concentrations of commercial space are projected to be along Congress Street and Northern Avenue. Approximately 48 percent of the transit riders would be destined to locations within a quarter mile radius of the World Trade Center ferry service and 64 percent within a quarter mile radius of ferry service if there were docks at both World Trade Center and Fan Pier (at the Northern Avenue bridge). Considering only those riders who were projected to use the North Station shuttle (and excluding riders to the BMIP and Summer Street area served by Route 6), the percentage of

riders within walk distance of ferry service (roughly .4 miles) would be considerably higher, perhaps 90 percent. Thus, most of the destinations of North Station shuttle bus riders would be within reasonable walk distance of water shuttle services to the Fan Pier and World Trade Center. However, the bus service may bring many travelers closer to their destination.

Walk distance is but one component of the rider's choice of mode among transit options. Travel time and frequency are others. The 2010 Inner Harbor ferry network in the 1989 Massport study envisioned service between North Station, Fan Pier, and World Trade Center operating every 15 minutes using four vessels and carrying 600 passengers per hour. It would be difficult for a ferry operating every 15 minutes to compete with a bus operating every 5 minutes, unless travel times are drastically different. The 1989 study compared 2010 ferry and land-based transit travel times. Travel to the Fan Pier would be 3 minutes faster by ferry while travel to the World Trade Center would be 2 minutes slower due to time spent at the intermediate Fan Pier stop. With competitive travel times, one would assume that frequency and walk distance would determine whether passengers choose ferry or bus.

If walk distance were equal for ferry and bus and frequency of service were the only deciding factor, the bus would have an significant advantage due to its greater frequency. It could be assumed that only 25 to 33 percent of the riders would have a choice of ferry service based on its share of departures per hour. However, since walk distance from the dock would be greater than from a shuttle bus stop for some portion of riders, some of the above potential riders might opt for the bus. Based on walk distance considerations, perhaps 25 percent of the potential ferry riders would opt for the bus. Combining frequency and walk distance considerations, it is estimated that only 20 to 25 percent of the North Station shuttle bus riders would use the ferry service as proposed.

Given the above estimate of the ferry share and the estimated ridership for the North Station Shuttle[15], the ferry service operating concurrently with the Transitway shuttle bus service would be carrying loads of only about a third of its capacity and would carry only about half of the 900 riders forecast in the 1989 study. This suggests that the ferry service would require a larger subsidy than the $2 per trip (in 1989 dollars) forecast in the 1989 study. Futhermore, provision of both bus and ferry services would cost more than provision of only bus service since the ferry requires capital acquisitions such as a dock and vessels, as well as higher per rider operating costs. (Note that bus subsidies per passenger for the shuttle bus service would be $1.10 assuming revenue based on full fare and $1.70 assuming no revenue from shuttle bus fares.) Finally, the impact of the ferry ridership on bus service would be to reduce the peak bus requirement by about four to five buses. This would yield some cost savings for the bus service. It would not substantially deteriorate bus level of service, since the bus route would still be much more frequent than the ferry, operating every 5 minutes in the high growth scenario.

The conclusions of this brief analysis of water transportation are as follows:

1. *Water transportation could play a support role in transporting riders to the Piers area, particularly from North Station.*

2. *Because the water transportation service would not offer significantly improved travel times, fares, frequency of service or distribution, the addition of water transportation is unlikely to generate a net increase in transit riders. Instead it will be likely to claim a share of the already projected bus ridership.*

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[15] According to the ridership projections detailed in Section 4.4, the North Station shuttle bus would carry 3,500 daily riders in the 2010 high growth scenario and 1,000 in the peak hour. Looking at the peak load crossing the Fort Point Channel, there would be nearly 1,000 riders in the a.m. peak hour in the high growth scenario. Ferry service would therefore attract 200 to 250 riders in the peak hour and about twice that number in the peak period.

Nevertheless, there should be only minor impacts on the proposed Transitway and surface bus plan.

3. *The provision of water transportation service will add cost to the overall transit service plan, but will remove some buses from the local streets and offer riders a pleasant transit alternative.*

These conclusions are preliminary since MHD is updating the study of inner harbor water transportation. The MBTA is awaiting the results of this study and will cooperate with MHD, Massport, and the GSA to achieve a water transportation alternative to the Piers area that is consistent with the study's findings on feasibility.

4.7.3 Integration of the Transitway with Water Transportation Services

It was suggested by some commenters on the DEIS/SDEIR that the Transitway be designed to be integrated with water transportation, that is, locate the Transitway stations to facilitate transfers and the use of the Transitway as an access/egress mode for water transportation. This section describes the manner in which the existing design serves this purpose. The potential use of the Transitway as an access/egress mode for water transportation does not justify any changes to the design, since there are overiding station location considerations based on both engineering issues and the primary goal of the Transitway which is to transport travelers to the Piers area developments from major downtown transportation facilities.

The prior Massport studies of water transportation envision that the South Boston Piers area will be served by inner harbor ferries that will connect the World Trade Center (and possibly the Fan Pier) to three locations: 1) North Station, 2) Long/Central Wharf, and 3) Charlestown Navy Yard. However, the siting of dock sites and the feasibility of water transportation services to the Piers area is uncertain. As noted above, two additional Fort Point Channel sites are being considered in the ongoing MHD/Massport water transportation study. The Federal Courthouse FEIS identified the possibility of a docking facility at the Courthouse/Fan Pier site and suggested support for inner harbor water taxi (small vessel) service as well as an alternative dock for the Hingham to downtown service. For the purposes of this discussion of service integration, it is assumed that the network in the 1989 study is in place and that the docks in the Piers area are located at the World Trade Center and Fan Pier.

The advantage of integrating the Transitway with these water shuttle services would be an expansion of the area accessible to these water shuttle services. At the same time, integration will depend on trade-offs of travel time, frequency, fares, and access. The Transitway could bring water shuttle passengers to and from BMIP, Summer Street, residential South Boston, South Station, Chinatown Station, and Boylston Station. Some of these locations, however, may be better served by other transit services. Table 4-8 shows alternative land-based transit routes. Examples of trips that would be better served by land-based transit are: 1) North Station to Chinatown Station (via the Orange Line or the Green Line); 2) Long Wharf to South Station or BMIP (via Route 6 bus service).

The Transitway's Courthouse Station is located under New Northern Avenue between Farnsworth and Pittsburgh Streets. This is a little more than 500 feet from the Fort Point Channel and a little over 800 feet from the eastern waterside of Pier 2 or the waterfront of Pier 1 (Courthouse site on Fan Pier). Although the station is not directly adjacent to a potential dock location, it is within reasonable walk distance. Until specific further plans are developed, it is difficult to attempt to integrate the Transitway design with a possible Fan Pier dock. The Transitway station siting was also constrained by several factors which limit its ability to serve a Fan Pier dock site. These factors have caused the station to be located on New Northern Avenue a short distance from the waterfront edge. These factors are:

TABLE 4-8: ALTERNATIVES TO FERRY SERVICE TO THE SOUTH BOSTON PIERS AREA

Dock (origin): / Destination:	North Station	Long/Central	Charlestown Navy Yard	
			Peak	Off Peak
Boylston	Green Line	Blue & Green Lines	Russia Wharf	Route 92 or 93 & Green Line
Chinatown	Orange Line	Blue & Orange Lines	Russia Wharf	Route 92 or 93 & Orange Line
South Station	Orange & Red Lines	Route 6	Russia Wharf	Route 92 or 93
BMIP	Route 6	Route 6	Russia Wharf & Route 6	Route 92 or 93 & Route 6
City Point	Orange & Route 9	Route 6 & Route 7	Russia Wharf & Route 7	Route 92 or 93 & Route 7

1. *Attempting to remain under public right-of-way and thus preserve developability of waterfront sites; and*

2. *Maximizing the walk catchment area of the station; and*

4. *Engineering and environmental constraints.*

The World Trade Center dock site was proposed to be on the northwest side of Commonwealth Pier along Northern Avenue. This site is also within walk distance (about 700 feet) of the proposed World Trade Center Station, which is located south of New Congress Street between Viaduct Street and D Street. Again, it is not directly adjacent to the station: a 2.5-minute walk would be required to transfer to the Transitway. The World Trade Center Station was located along Congress Street in support of the BRA's development plans for Piers area and to maximize its ability to serve development along all three Piers area east-west thoroughfares — Northern Avenue, Congress Street, and Summer Street. Locating the station closer to the waterfront would reduce the catchment area, interfere with existing uses, and present difficulties in the siting of the tunnel portal.

In conclusion, the alignment and station locations of the Transitway were developed for optimal service to the anticipated developments and subject to engineering constraints. Integration with water transportation services that have not been fully designed was not feasible. Furthermore, the demand for Transitway access to the various anticipated water ferry services will be limited due to competitive land-based services. Nevertheless, the stations are located within a reasonable walk distance of likely dock sites at the Fan Pier and World Trade Center, so that passengers can make these transfers. Changes to the Transitway design do not appear to be justified for the purposes of enhanced integration with water transportation. While station locations have been finalized in this FEIS/FEIR, the MBTA will cooperate with the future findings of the MHD Inner Harbor Study in subsequent stages of project implementation.

CHAPTER FIVE
Environmental Consequences

CHAPTER 5. ENVIRONMENTAL CONSEQUENCES

5.1 INTRODUCTION

This chapter describes the social, economic, and environmental impacts of the transit alternatives. For each alternative, significant impacts in the following categories are highlighted: neighborhoods, land use, right-of-way, relocations, and economic activity; energy; aesthetics; air quality; noise and vibration; ecosystems; water resources; sediment disposal; archaeological resources; historic resources; and parklands.[1] ***Mitigation for impacts associated with the locally preferred alternative — the Full Build Underground Transitway — is summarized at the end of this chapter.***

5.2 NEIGHBORHOODS, LAND USE, AND ECONOMIC ACTIVITY

As discussed in Chapter 3, the impacts of the transit alternatives are focused on the project service area which is comprised of the South Boston Piers/Fort Point Channel area and downtown Boston. The analysis of impacts is based primarily on the perceptions of community leaders and representatives of neighborhood groups, businesses, institutions, and property owners combined with an analysis of the construction methods, operating strategies, and transportation impacts of each alternative. Key impact categories analyzed are: neighborhood life; access to community facilities; visitor access to institutions; station access; property acquisitions, takings, or easements; consistency with public and private development plans and adjacent land uses; and short- and long-term impacts on economic activity.

In the sections below, potential impacts are organized by alternative. Except for employment opportunities afforded by construction and operation of each alternative, all impacts to neighborhoods, land use, and economic activity are presented by affected area. Employment is presented as an aggregate impact since it cannot be apportioned to a particular area. At the conclusion of this section, Table 5-2 summarizes key economic impacts of each alternative.

5.2.1 No Action Alternative

Almost 65 new staff positions, including operators and maintenance and administrative personnel, would be created by the No Action Alternative in both growth scenarios. Since no construction is required, no short-term employment opportunities would be generated.

5.2.1.1 South Boston Piers/Fort Point Channel Area

The relatively minor increase in conventional surface buses provided by this alternative would have little impact on the Piers area neighborhood. However, museum directors have voiced concern that increased bus volumes on Congress Street could cause safety problems for visitors, particularly children, to Museum Wharf.

The most significant impact of the No Action Alternative on land use and economic activity is the alternative's inability to support ***not only near-term development projects approved for the Piers area, such as the new Federal Courthouse and the World Trade Center expansion, but the larger*** development goals for the area; these goals are described in the Boston Redevelopment Authority's (BRA)

[1] A complete description of impacts and assessment methodologies is provided in the *Social, Environmental, and Economic Impacts Assessment Methods and Results Report* (MBTA, November 1992) published as part of the DEIS/SDEIR.

Fort Point District Plan and quantified in the land use estimates prepared for the Massachusetts Highway Department's (MHD) Central Artery/Third Harbor Tunnel Project. The relatively low level of transit service provided by this alternative means that many commuters to the Piers area would drive, causing substantial deterioration of traffic and environmental conditions. In such a situation, the city and state might not approve many of the projects planned for the Piers area, resulting in greatly reduced development for the area.

While some of this development may be redistributed to other locations in Boston and possibly throughout the region, the policy for the Boston area is to focus new development on an area that will be well served by existing and improved infrastructure. Such focused development both supports and is supported by various infrastructural elements, including transit. The fundamentally unique characteristics of the Piers area, such as adjacency to downtown Boston and Logan International Airport, deep port capabilities, and full interchange to the Interstate highway system and other transportation infrastructure, make the area a logical focus for future development.

To estimate the amount of development that would likely be lost in the Piers area if the No Action Alternative is implemented, land use inputs to the traffic model were adjusted until the resulting traffic volumes were found to allow the street intersections to operate at acceptable levels. For the purposes of this analysis, acceptable traffic conditions are defined as level of service (LOS) D or better at all key Piers area intersections. This criterion is also included in the project's traffic and air quality impact analysis methodology.

As shown in Table 5-1, the Full Build Alternative's p.m. peak hour vehicle trip table contains 37.8 percent fewer vehicle trips than the trip table for the No Action Alternative. Therefore, a 37.8 percent reduction in the No Action Alternative's vehicle trip table would be needed to ensure that acceptable traffic conditions occur in the Piers area during the p.m. peak hour. This reduction translates into a loss or redistribution of 8.2 million square feet of the official 2010 forecasted development (*i.e.*, the high growth scenario) for the Piers area.

TABLE 5-1: P.M. VEHICLE TRIP ENDS IN 2010 VERSUS THE FULL BUILD ALTERNATIVE

Alternative	Total 2010 High Growth P.M. Vehicle Trip Ends*	Trip Ends in Excess of the Full Build Alternative
Full Build	7,824	---
MOS	8,166	4.2%
Bus/TSM	9,100	14.0%
No Action	12,575	37.8%

* Includes automobiles, high occupancy vehicles, and trucks.

Since traffic analysis described previously in Chapter 4, Section 4.6.2, shows that the Full Build is the only alternative that supports full high growth scenario development of the Piers area with acceptable traffic conditions, it is used as the baseline against which all other alternatives are compared. As the baseline, the Full Build Alternative's p.m. peak hour vehicle trip table containing approximately 7,800 trips represents

close to the maximum number of trips that could be accommodated in the Piers area under acceptable traffic conditions. However, the Full Build Alternative supports not only the 21.7 million square feet of development forecast in the 2010 high growth scenario, but, with some operational modifications, also offers the potential to serve additional development as well.

The impetus for development of the Piers area is based chiefly on its unique locational advantages. With connections to the regional highway network and Logan International Airport provided by the CA/T Project, the long neglected and currently underutilized Piers area is a natural site for new development once the economy recovers. The high growth scenario goal of 21.7 million square feet of development in the area by 2010 may be followed by even more growth as the Boston metropolitan region avails itself of trade opportunities with the Pacific Rim, the European Community, and Eastern Europe.

In order to evaluate the possible impacts of transit services in relation to such additional growth, the theoretical additional development (over and above the 2010 high growth scenario) which could be supported in the Piers area was estimated based on an assumed conversion of the Full Build Transitway to light rail operation. The resultant increase in peak hour passenger capacity of 10,700 passengers translates into a potential for additional development of 7.1 million square feet. Consequently, since no opportunity exists in the No Action Alternative to increase transit capacity through the conversion to light rail, development potential above the 2010 high growth scenario could not be supported by the No Action Alternative. In total, *up to* 15.3 million square feet of potential development throughout the Piers area could be lost or redistributed to other locations in the region.

While this analysis assumes that the percentage reduction in vehicle trips is equivalent to the loss of Piers area development potential, this lost or redistributed development opportunity must be viewed as a worst case scenario. For example, it is reasonable to assume that other factors, such as peak spreading (the shifting of some trips beyond the peak hour), greater use of carpools, and a different mix of development that stresses off-peak trip generation, such as retail and industrial uses, would combine to limit the actual ceiling on development required to achieve acceptable traffic conditions.

5.2.1.2 Downtown

Modest increases in surface bus volumes in the downtown portion of the service area would not have any significant impacts on neighborhoods, land use, or economic activity in Chinatown and the Midtown District. Residents of the area, however, would not enjoy substantially improved access to jobs and cultural resources in the Piers area, nor would visitor access to the Chinatown/Midtown District be much enhanced.

In the South Station area, development goals would not be well supported by the No Action Alternative. For example, the proposed reuse of land created by the depression of the Central Artery calls for predominantly structured open space accessible to city residents and visitors. Specific plans include an arboretum, botanical gardens, and parkland. In the high growth scenario, excessive traffic congestion associated with this alternative (described previously in Chapter 4, Section 4.6) would not be compatible with these pedestrian-oriented activities. In addition, the perpetuation of high traffic volumes and resultant pedestrian conflicts in the South Station area would not be consistent with either the residential component of the Harbor Plaza expansion or the hotel element of the South Station Technology Center project. The lower growth scenario would result in a similar situation but with less severe traffic and pedestrian conflicts.

5.2.2 Bus/TSM Alternative

The increased bus operation provided by the Bus/TSM Alternative would create over ***275*** long-term jobs in the high growth scenario, including additional operation, maintenance, and administrative positions. The lower growth scenario would create ***149*** jobs. Construction of the transit elements associated with the alternative is expected to generate up to 170 person years of short-term employment opportunities.

5.2.2.1 South Boston Piers/Fort Point Channel Area

The Bus/TSM Alternative would result in the highest volume of surface buses of any of the proposed alternatives. High traffic volumes projected for the Piers area neighborhood's major streets in 2010 under this alternative (Summer Street, New Congress Street, and New Northern Avenue) could limit the ability of the area to develop as a cohesive community. Although the surface buses proposed in the Bus/TSM Alternative would reduce overall traffic, large volumes of surface buses tend to be an identifiable target for residents who feel that traffic is negatively affecting neighborhood quality. Residents have stated this point of view in numerous interviews.

Museum Wharf directors are concerned that the high volume of buses could create safety problems, real and perceived, for museum visitors, a majority of whom are under 10 years of age. Bus volumes would be high on those streets used by visitors to reach the museums. On New Northern Avenue, for example, high growth scenario peak hour bus volumes would total 78 at Congress Street, 38 at Museum Wharf, and 72 between the East and West Service Roads. According to museum officials, the vast majority of visitors — 71 percent — come to the Museum Wharf by automobile. These officials explain that the low use of public transportation is due to the lack of full accessibility on the system, and parents with small children, strollers, and parcels find it difficult to board and alight from buses and trains. Moreover, since the museums do not own their own visitor parking lots, they must make parking arrangements with property owners throughout the Piers area. With the many construction projects already underway in the area, museum officials must seek parking areas farther and farther from their facilities, thus necessitating walks of four and more blocks for many of their visitors.

The need to walk along and across heavily trafficked roadways filled with buses and automobiles is perceived as a hazard for museum visitors according to Museum Wharf staff (personal communication, January 1992). Despite the increased bus services provided by the Bus/TSM Alternative, museum spokespersons have said that travel time is not the sole method of measuring access for visitor groups which include small children. Intermodal transfers, which are easily accomplished by able-bodied and unencumbered passengers, become very trying and difficult for an adult traveling with two small children, a stroller, and other items needed to care for children on a day's outing.

The impact of large volumes of buses could be mitigated by the installation of pedestrian lights at heavily used intersections such as Congress Street and Atlantic Avenue. Moreover, the redesign of Congress Street should include as many urban elements as possible since studies show that drivers lower vehicular operating speeds in highly urbanized areas. Provision of a traffic officer at key crossing points on Congress Street and New Northern Avenue during periods of heavy patronage of Museum Wharf would also help to ensure safe pedestrian access to the museums.

Passenger facilities at Fan Pier and the World Trade Center would be well-located to serve proposed development in the Piers area. These facilities would also be consistent with the city's goal to include transit stations as highly visible elements in the development plan for the area. ***As indicated above, these urban elements also create a safe pedestrian environment.*** However, the facilities would cut into sidewalk space and create a jagged streetfront. As such, these facilities are not compatible with the urban design objectives of the Piers area which call for a regularized streetfront and sidewalk pattern.

The construction of a bus lane, bus pullouts, passenger facilities, and a storage and maintenance facility in the Piers area would have some economic impact on the owners of properties affected by the takings required for this new infrastructure. For example, the taking of Massachusetts Port Authority (Massport) property on New Congress Street would require the modification of development plans in the area affected by the 23,300 square foot taking. Massport's plans for this area call for expansion of the existing World Trade Center, a project that is already well advanced in the planning stage.

Construction of a bus lane on New Congress Street, while enhancing operation of buses in the Bus/TSM Alternative, would displace curb lane parking to the westbound median of the street. This proposed plan is not compatible with the city's concept of New Congress Street as a major urban boulevard consisting of a tree-lined central island and broad sidewalks with double rows of trees. Furthermore, the city's plan

to create a pedestrian-friendly experience along the boulevard could be disturbed by the frequency of buses traveling in the westbound bus lane adjacent to the sidewalk. While the HOV lane would only be constructed for the Bus/TSM Alternative in the high growth scenario, ***the right-of-way would be purchased in both scenarios to preserve the ability to construct the lane if warranted by future increases in demand.***

A Seattle based study has shown that when streets are wider than three lanes, drivers behave more aggressively than on narrower streets of three lanes or less. On wider roadways, a driver's field of vision primarily encompasses the roadway and other drivers rather than walkers or buildings. Mitigating measures could be to install pedestrian signal lights and to create a streetscape that has as many urban elements as possible in order to slow vehicular operating speeds.

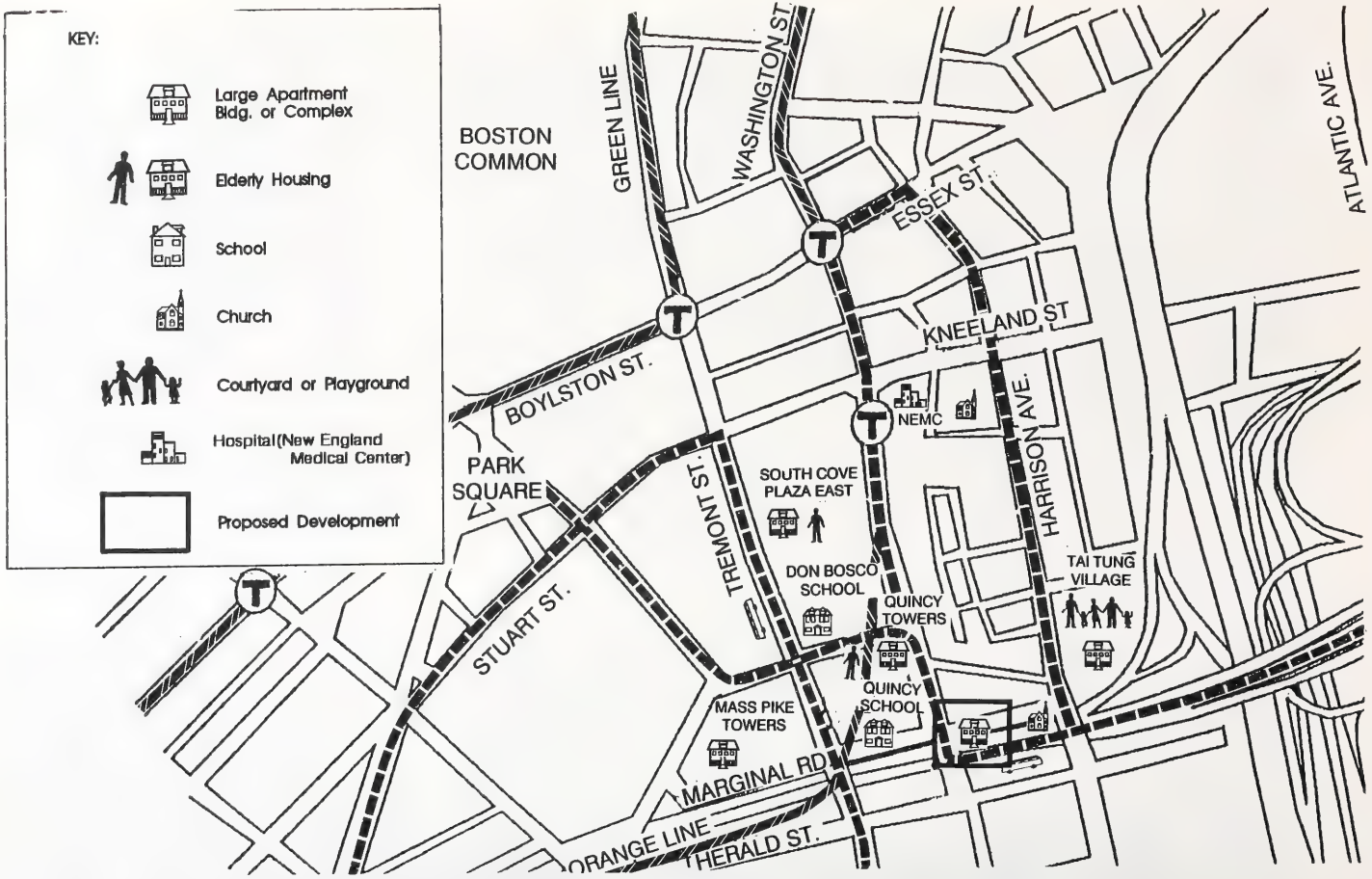
Measures aimed at mitigating potential construction related impacts of the Bus/TSM Alternative include coordination with public and private construction activities. In particular, the construction of the bus lane would be coordinated with the city's schedule to construct New Congress Street. Additionally, design of a passenger facility on New Congress Street would be coordinated with the World Trade Center expansion in order to maximize visual consistency and to ensure convenient access to both the facility and the expansion project.

Depending upon the site selected for construction of a bus storage and maintenance facility, relocation of some tenants would be required. Site A on the corner of Summer Street and Pappas Way is approximately 10 acres and consists of open air parking and two buildings. The site's owner, Massport, has leased the site to Diversified Automobile, Inc., a subsidiary of Subaru, Inc., for automobile storage; Monotype Binding, a printing and composition company; and Executive Courier. Tenants of Site B, a 7.8-acre site at the southern end of the parcel which is also owned by Massport, include Fortress Records, CPC Corp. Printing Co., Shaughnessy Warehouse, and Roadway Trucking. Since any relocated companies would be given adequate time and assistance to find alternative sites, no negative economic impact is anticipated.

Increased surface bus volumes associated with the Bus/TSM Alternative, while improving transit access, would contribute to traffic congestion on many Piers area streets. Given this congestion and related negative environmental impacts, full buildout of the area could be hindered. Based on the traffic and land use analysis described previously in Section 5.2.1.1, it is estimated that the Bus/TSM Alternative would result in a loss or redistribution of 10.1 million square feet of potential development throughout the Piers area. Roughly 30 percent of this total (3.0 million square feet) represents the loss or redistribution of development projected for the 2010 high growth scenario. The remaining 7.1 million square feet reflects the inability to expand capacity through the conversion to light rail and therefore support potential post-2010 development.

5.2.2.2 Downtown

Chinatown's neighborhood would perceive the large number of surface buses in the Bus/TSM Alternative as having a negative impact on neighborhood life, including social cohesion and residential stability. For example, buses on Marginal Road (one bus roughly every 1.4 minutes in the a.m. peak hour) would pass directly by the site at the corner of Washington Street where 80 to 100 units of affordable housing will be constructed. Several other sensitive receptors (housing, schools, day care centers, and health clinics) are located along the proposed bus routes. These include Quincy Towers, housing for the elderly; Tai Tung Village and MassPike Towers, family housing complexes that also contain daycare centers, health clinics, and playgrounds; and Don Bosco High School and Quincy Elementary School. Proposed housing sites for other large multi-family structures are also located along surface bus routes operated in the Bus/TSM Alternative. Figure 5-1 shows the relationship of Chinatown's housing and schools to some of these bus routes. Heavy surface bus volumes could limit the ability of Chinatown to achieve its goals of a strengthened family orientation, protection of the existing land base and expansion south and west, and enhancement of Chinatown's cultural and historic heritage reflected in its unique streetscape and pedestrian environment.



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 5-1
Bus Routes through Chinatown Residential Area

An unmanned passenger facility and two-berth bus pullout would be constructed on Oak Street near the Don Bosco High School. This facility would improve both passenger activities and bus operations by consolidating them in one location. Construction of this facility would require a minor taking from sidewalks and walkways at the high school.

In addition to the passenger facility, new curbside stops would be created. Multiple buses, if combined with intersections which are frequently blocked by vehicular traffic (a near gridlock condition that frequently occurs during rush hours), could create pedestrian movement problems on Tremont and Washington Streets. Although these streets are wide, there is significant pedestrian activity associated with schools, daycare, health services, and housing complexes. Limited space at New England Medical Center Station on the Orange Line could cause safety problems for transferring passengers and pedestrians. Mitigating measures would include selection of curbside stop locations that would permit passengers and bus drivers to view potential conflicts.

Neighborhood representatives of Chinatown and the Midtown District question the benefits afforded by increased bus volumes on local streets in relation to the traffic congestion generated. Representatives of Midtown District organizations have stated in interviews with the consultant team that surface buses are an inadequate solution to traffic congestion, and that buses are not an attractive transit mode for theater-goers.

The increase in surface buses operated in the Bus/TSM Alternative is generally inconsistent with the development and community goals of Chinatown, the Midtown District, and the South Station area. In the South Station area, the extensive operation of buses on surface streets would not be consistent with the parkland/open space uses proposed as part of the Central Artery reuse plan, nor with the hotel/residential uses proposed as part of the South Station air rights and Harbor Plaza expansion projects.

5.2.3 Fort Point Channel Underground Transitway/MOS-1 Alternative

The MOS-1 Alternative would create ***359*** long-term jobs associated with the operation, administration, and maintenance of its transit services and facilities in the high growth scenario. The lower growth scenario would result in the creation of ***almost 205*** jobs. Construction activity, including the Transitway tunnel from South Station to Fan Pier, would generate ***roughly 2000*** person-years of short-term employment opportunities.

5.2.3.1 South Boston Piers/Fort Point Channel Area

The MOS-1 Alternative would provide an excellent connection to community facilities in downtown Boston for Sleeper Street residents and future residents of the Piers area neighborhood. Since community facilities are not yet developed in this neighborhood due to the current low number of residents, community facilities outside the neighborhood are used. Given its interconnectivity with the existing transit system, the MOS-1 Alternative would also provide improved service to Museum Wharf.

The development of the Fort Point Channel Underground Transitway from South Station to Fan Pier (MOS-1) would require a number of private and public easements and takings for construction of the tunnel and surface facility at Courthouse/Fan Pier. Although the majority of takings are minor in size and would not significantly impact development plans for these properties, the MOS-1 Alternative would require a full taking of the Victoria Station restaurant resulting in the displacement of 65 jobs, only 10 of which are classified as full-time (30 hours per week or more). A taking would also be required from the McCourt property in the area of New Northern Avenue for the construction of a surface Transitway station and portal. This taking is over one acre in size and would have an impact on future development of the property.

In addition, a storage and maintenance facility would need to be constructed to service and store articulated trackless trolleys and the supporting surface bus fleet. ***This facility would be located on one of the two sites identified for the Bus/TSM Alternative.*** Existing tenants on these sites would need to relocate before construction of the storage and maintenance facility could begin. Because such businesses would be given ample time to identify alternative sites, no permanent impacts would occur.

Although the alignment of the MOS-1 Alternative would be subsurface from South Station to Courthouse/ Fan Pier, the area east to World Trade Center and the Boston Marine Industrial Park (BMIP) would be serviced by standard buses and trackless trolleys powered from overhead catenary operating on surface streets. Because of the high volume of transit vehicles on surface streets, the MOS-1 Alternative would not appreciably alleviate traffic congestion on portions of New Northern Avenue, New Congress Street, and other major roadways in the Piers area. Therefore, the alternative would not be compatible with the *Fort Point District Plan* goals of improved pedestrian access and circulation, particularly along the commercial corridors. Furthermore, the surface operation of buses along New Congress Street would conflict with the BRA's vision of this street as a central boulevard and focus of development. Boulevards are typically associated with moderate traffic volumes in which both walkers and cars share the roadway corridor. The corridor is highly landscaped to encourage strollers, and shops and restaurants are located along the boulevard to attract people. In this sense, boulevards become strong community focal points. However, if large numbers of surface buses combined with heavy volumes of automobiles occur along the roadways, they can become primarily traffic corridors which may mechanically move people, but will not attract them as strollers, customers, or residents.

The surface operation of standard buses and Transitway vehicles would compete with regular traffic for street capacity and would be forced to make passenger stops along major routes. Such stops would only further aggravate bottlenecks and would conflict with the *Fort Point District Plan* goal to restrict vehicle encroachment on public open space and pedestrian areas. Sensitive design of the trackless trolley overhead catenary would be needed to conform to the overall aesthetic environment envisioned by the *Plan*.

A surface station at Courthouse/Fan Pier, located east of the portal between Farnsworth and Pittsburgh Streets, would be easily accessible from Fan Pier or Museum Wharf, and would support the development of the new Federal Courthouse at Fan Pier. Because the Federal Courthouse is expected to be one of the earliest of the new developments in the Piers area, the MOS-1 Alternative would support the area's short-term development goals. The lack of a tunnel connection to midtown means that additional surface shuttle bus routes are needed to provide transfers to the Piers area from the Green and Orange Lines. In the high growth scenario, these surface bus routes contribute to unacceptable traffic conditions in the eastern end of the Piers area. As a result, a modest reduction in development would be needed to ensure acceptable traffic and environmental conditions. Based on the traffic and land use analysis described previously in Section 5.2.1.1, it is estimated that implementation of the MOS-1 Alternative would support one million fewer square feet of Piers area development in 2010 than envisioned in the high growth scenario. This alternative would support all development projected in the lower growth scenario.

Residents, employees, and visitors would be exposed to noise and dust as construction for the underground tunnel and portal occurs. Moreover, access to museums could be disrupted during construction. Between 130 and 250 parking spaces serving the Children's Museum may be relocated by the CA/T Project from the Museum's current lot on Congress Street to a temporary lot between the proposed alignment of New Northern Avenue and the northern end of the Boston Wharf Company. If the parking is relocated to a lot in this area, it would later be taken by the MBTA for construction of the Transitway tunnel. The MBTA would work with Children's Museum officials to relocate museum parking elsewhere in the vicinity of Museum Wharf. The Children's Museum has also expressed a desire to seek permanent parking close to its facilities.

The MBTA would coordinate construction scheduling of the MOS-1 Alternative with other Piers area projects in order to minimize construction impacts.

5.2.3.2 Downtown

Transit service in the MOS-1 Alternative would be provided by surface buses in the downtown portion of the service area. Since bus volumes would be similar to those in the Bus/TSM Alternative, impacts to neighborhoods, land use, and economic activity would also be the same. These impacts include high bus volumes on streets adjacent to sensitive receptors and congested traffic conditions particularly in

Chinatown, which is a major downtown residential area with significant elderly and adolescent population groups (see previous Section 5.2.2.2).

MOS-1 elements in the South Station area include a Transitway station at South Station and an underground tunnel alignment along Atlantic Avenue ***to Congress Street. At Congress Street, the alignment turns east beneath Russia Wharf and a portion of the Boston Edison property.*** Because South Station is under the control of the MBTA, no easements or takings would be required. Construction of the Transitway station above the Red Line at South Station would be scheduled so as to limit the impact on Red Line users. Coordinated construction of the Transitway tunnel with the northbound Central Artery along Atlantic Avenue would effectively eliminate any additional construction impacts associated with the Transitway in this area. However, ***a temporary construction easement of 51,130 square feet and a permanent subsurface easement of 11,000 square feet would be required at Russia Wharf, while a temporary construction easement of 30,000 and a permanent subsurface easement of 13,000 square feet would be required at the Boston Edison parcel in order to make the transition from Atlantic Avenue to the Fort Point Channel crossing. Although some temporary disruption would occur during construction at both Russia Wharf and the Boston Edison parcels, no permanent impacts to either property, including the future development of the Boston Edison parcel, are anticipated.***

The underground alignment of the MOS-1 Alternative in the South Station area would be consistent with public and private development plans to strengthen the recreational, residential, and commercial viability of this area of downtown. The MOS-1 Alternative would improve traffic flow in the area by reducing surface bus volumes. Improved traffic conditions would relieve noise and air quality problems and would result in a better pedestrian environment. The improved traffic, environmental, and pedestrian conditions afforded by the MOS-1 Alternative would in turn support the proposed transition of the area into a more diverse economic area.

5.2.4 Fort Point Channel Underground Transitway/MOS-2 Alternative

The MOS-2 Alternative would create approximately ***359*** long-term jobs associated with its operation, administration, and maintenance in the high growth scenario. The lower growth scenario would create approximately ***210*** jobs. ***Approximately 2,800*** total person-years of short-term construction employment would also be generated.

5.2.4.1 South Boston Piers/Fort Point Channel Area

In the MOS-2 Alternative, underground stations would be constructed at Courthouse/Fan Pier and the World Trade Center, with Transitway service coming to surface at a portal in the vicinity of D Street. Such underground transit service would be consistent with neighborhood goals in the South Boston Piers/Fort Point Channel area. Underground operation would avoid disruption to neighborhood street life and aesthetic character, access to the waterfront, and the social cohesion of the developing residential areas. Service provided by this alternative would provide improved transit accessibility to those community facilities that can be expected to develop as Piers area neighborhoods grow. Furthermore, its interconnectivity with the overall transit system would enhance accessibility.

Because the entire MOS-2 Alternative alignment would be subsurface throughout the Piers area, it is also more compatible with proposed public and private development goals. However, while the alternative would relieve traffic congestion on major surface streets in the Piers area, including the New Northern Avenue and New Congress Street commercial corridors, unacceptable traffic conditions elsewhere in the Piers area would preclude full buildout in the high growth scenario. Based on the traffic and land use analysis described previously in Section 5.2.1.1, this alternative would support one million fewer square feet of development for the Piers area than envisioned in the 2010 high growth scenario.

The location of the two Piers area transit stations would support the linear development of the commercial boulevards. In addition, the stations would support development pockets within the Piers area. The Courthouse Station would be easily accessible from the Federal Courthouse and development at Fan Pier as well as from Museum Wharf. ***To facilitate safe, convenient passenger access to Courthouse***

Station, the station's design includes a mezzanine which would extend under New Northern Avenue to Farnsworth Street. The mezzanine permits the location of entrance/exit kiosks on both sides of New Northern Avenue, thus avoiding the need for passengers to cross heavily trafficked New Northern Avenue at surface to access the Transitway. A "free zone" within the mezzanine allows pedestrians to cross New Northern Avenue below grade, without paying a fare to enter the Transitway. Likewise, the World Trade Center Station would be located within walking distance of the existing World Trade Center and proposed expansion facilities.

The development of the Fort Point Channel Underground Transitway from South Station to World Trade Center (MOS-2) would require numerous private and public takings/easements for construction of the tunnel and subsurface facilities at Courthouse/Fan Pier and the World Trade Center. As in the MOS-1 Alternative, a full taking of the Victoria Station restaurant would be required. The underground station ***at Courthouse/Fan Pier would be located fully beneath New Northern Avenue, thus avoiding impacts to developable parcels associated with the MOS-1 surface station facility.*** No taking would be needed for construction of the World Trade Center Station, since Massport has agreed to incorporate the transit station into its replacement parking garage. The tunnel alignment from Courthouse/Fan Pier to World Trade Center (described in Chapter 2, Section 2.3.3.2) ***will require a permanent subsurface easement of 7,400 square feet and a temporary taking of 51,700 from the McCourt parcel at the corner of New Northern Avenue and East Service Road. This portion of the alignment may also require a taking of the New England Seafood Center building; alternatively, the building may be underpinned. In either case, a permanent subsurface easement of 21,270 square feet would be required.***

The New England Seafood Center is a brick and concrete structure containing a nightclub and fish processing and wholesale distribution companies. The building contains approximately 85,600 square feet and was built in two sections. The section which fronts on Northern Avenue was constructed in 1954, and the rear portion was constructed in 1970. The New England Seafood Association, a cooperative of small companies, has owned the building since 1970.

The building has loading docks on both sides, an essential feature of the fish companies' operations. Even the non-fish tenant, the Harbor Club night club, has a loading dock where beverages are loaded and unloaded. The portion of the lot which is not utilized by building or loading docks is occupied by parking spaces used during the day by employees and occasional visitors, and in the evening by patrons of the Harbor Club.

Ten fish processing and distribution companies and one night club occupy the building. Many of the fish companies are owners (i.e., members of the Cooperative) and were original members of the Cooperative. Building requirements for the fish processing tenants include low temperature working areas, refrigeration, and loading docks. Fish distribution tenants also require refrigeration and loading docks. Telephone interviews with fish processors, distributors, and brokers indicated the importance of being in close proximity to one another in terms of sharing information and marketing their products and services. All of the fish companies require good roadway access since fish are transported to and from the Seafood Center by truck. They would also like any future building to be in the vicinity of the Fish Pier. The decision whether to take or underpin the New England Seafood Center building will require coordination between the MBTA, MHD, the City of Boston, and building owners and occupants.

Finally, as with the MOS-1 Alternative, a storage and maintenance facility would be needed to service and store articulated trackless trolleys and standard buses. As indicated previously, ***two sites on a parcel managed by the Massport Maritime Department and bordered by Summer Street, Pappas Way, West First Street, and E Street are under consideration.*** Although any existing occupants would be required to relocate, sufficient time and assistance would be provided, and no economic impact is anticipated.

5.2.4.2 Downtown

Service provided in the downtown area as part of the MOS-2 Alternative would be identical to that provided in the MOS-1 Alternative. Therefore, impacts to neighborhoods, land use, and economic activity would be the same. See previous Section 5.4.3.2 for a discussion of these impacts.

5.2.5 Fort Point Channel Underground Transitway/Full Build Alternative

The Full Build Alternative would create over ***360*** long-term jobs associated with the operation, administration, and maintenance of new transit services and facilities in the high growth scenario and ***almost 202*** jobs in the lower growth scenario. Short-term employment opportunities totaling ***4,660*** person-years would be generated by the construction of new facilities.

5.2.5.1 South Boston Piers/Fort Point Channel Area

The alignment and station locations of the Full Build Alternative in the Piers area would be the same as for the MOS-2 Alternative. Operationally, however, shuttle service from Copley and New England Medical Center Stations provided in both the MOS-2 and MOS-1 Alternatives would not be necessary in the Full Build. Instead, the Full Build Alternative's downtown tunnel alignment would enable direct connections to the Green and Orange Lines at Boylston Station and Chinatown Station, respectively. The elimination of these surface shuttle services in the Full Build Alternative also helps to alleviate unacceptable long-term traffic conditions in the Piers area.

The demand for transit service to accommodate activities at the Federal Courthouse will occur in advance of the Transitway's construction. To serve this demand, interim bus service will be provided to the Piers area beginning in 1998 at the Courthouse opening. Peak hour bus volumes will be fairly high on Sleeper Street (16 at peak hour). This street is relatively narrow, and a residential complex is located here. The interim buses will also operate on that portion of Congress Street adjacent to Museum Wharf. However, bus volumes in the off-peak commuting hours will be much lower.

Mitigating measures to relieve the impact of the peak hour buses would include the monitoring of the buses' impacts on the environmental quality of Sleeper Street. At the Congress Street/Museum Wharf location, a pedestrian-actuated light would be installed, and a clear, well-striped crosswalk would be provided.

The bus fleet associated with the Full Build Alternative would require a storage and maintenance facility ***at one of the two sites described above for the Bus/TSM Alternative. The facility constructed for the initial Transitway implementation phase — MOS-2 — would be of sufficient size to support the Full Build fleet. As a result, no additional impacts on neighborhoods, land use, or economic activity are anticipated as a result of the phased implementation of the Full Build Transitway.***

Aside from supporting full buildout in the high growth scenario, all other long-term impacts of the Full Build Alternative to neighborhoods, land use, and economic activity in the Piers area would be the same as for the MOS-2 Alternative. These impacts are described in Section 5.2.4.1.

5.2.5.2 Downtown

The Full Build Alternative is the only alternative that would provide underground service in the downtown area and enable direct connections to the Green and Orange Lines. Access to the Green Line would be provided at a new Transitway station located one level below the existing platforms at Boylston Station. Another new Transitway station constructed on the block bounded by Hayward Place, Washington Street, Avenue de Lafayette, and Harrison Avenue would include a connection to the Orange Line via a pedestrian passageway to Chinatown Station. The Full Build Alternative is also the only alternative that provides an opportunity for eventual connection to Replacement Transit Improvement Service. (See Chapter 1, Section 1.4.1.2, *Anticipated Changes*, for a description of this proposed service.)

The Full Build Alternative's underground alignment, interconnectivity with the existing transit system, limitation of surface buses on local streets, and direct transportation to jobs and cultural resources in the Piers area are supportive of downtown community and development goals. As a permanent transit infrastructure, the Full Build Alternative reflects a strong public commitment to the downtown area.

Construction of the Underground Transitway from South Station to Boylston Station would require a number of small easements and takings in the downtown area. The BRA has expressed some concern that the construction of the Chinatown Station, adjacent to the Hayward parcel, could impact the future development potential of that site. The site is viewed as an important component of the Lafayette Place II project and may include housing for Chinatown residents. In addition to its market value in the Midtown District, the site is critical to Chinatown in that it is one of very few expansion areas remaining. The MBTA is aware of the sensitivity of this site and ***has designed the station to support future construction of a 400-foot building on the parcel.*** The MBTA will continue to work closely with the BRA in finalizing design of this station and any surface elements to appropriately complement the Hayward parcel.

Temporary construction related impacts to downtown neighborhoods and economic activity would be mitigated through the maintenance of pedestrian and vehicle access, provision of good signage, and selection of the least disruptive, feasible construction methods and staging. ***While construction of the downtown segment of the project is over a decade away, two chief objectives guide the MBTA's construction mitigation program in the vicinity of Boylston Station. These are to ensure uninterrupted Green Line service and to maintain safe and convenient access to the Boston Common. As construction plans for the new Transitway station are developed, provision would be made for pedestrian circulation to and on the southeast corner of Boston Common. In developing these access features, the MBTA will work closely with the Boston Parks and Recreation Department and the Boston Transportation Department (BTD). The MBTA is committed to providing safe pedestrian and passenger movement in and around the station and Common, and has extensive experience building and rebuilding stations in dense urban areas.***

TABLE 5-2: SUMMARY OF KEY ECONOMIC IMPACTS BY ALTERNATIVE

Alternative	Long-Term Employment (High Growth Scenario)	Short-Term Employment	Reduction in Piers Area Development Potential (High Growth Scenario)	Total Takings/ Easements
No Action	65	0	15.3 million sf	0 sf
Bus/TSM	275	***170***	10.1 million sf	39,375 sf
MOS-1	360	***2,000***	0.9 million sf	128,276 sf
MOS-2	359	***2,800***	0.9 million sf	86,823 sf
Full Build	363	***4,660***	None	124,543 sf

5.3 ENERGY IMPACTS

Regional energy impacts of the project would be the result of a reduction in automobile travel (as compared to the No Action Alternative), offset partially by the energy requirements for construction and operation of the alternatives.

Energy savings due to reduced automobile travel were quantified based on the number of automobiles diverted to transit and the mileage saved for each diversion. Total vehicle miles traveled (VMT) savings were converted to gallons of gasoline using a 20 mile per gallon average. This is somewhat less than the current average fuel economy, but reflects the congested stop-and-go traffic conditions in downtown Boston. For purposes of comparison, gasoline savings are converted to British Thermal Units (BTU) at the rate of 125,000 BTU per gallon.

Bus fuel economy is estimated at 4 miles per gallon, with a conversion factor of 135,000 BTU per gallon. Energy requirements for right-of-way and vehicle construction are based upon recent studies which indicate that an average of $77.6*10^9$ BTU is typically expended for every million dollars (1963 dollars) of transit construction. Similarly, $1.02*10^9$ BTU is required for construction of a single bus. The one-time construction energy consumption for right-of-way and vehicles were made comparable to annual VMT values by spreading construction energy usage over a facility life of thirty years and a bus life of twelve years.

Table 5-3 shows the net energy impact of each proposed alternative. All of the alternatives exhibit significant potential for energy savings. For the Transitway Alternatives, energy savings are slightly reduced in comparison to the Bus/TSM Alternative due to the energy required for construction of the tunnel and stations. Construction and procurement elements contributing to energy usage are based on the high growth operating scenario for the respective alternatives.

5.4 AESTHETIC IMPACTS

This section discusses the potential visual effects of the proposed alternatives. The alternatives would alter the physical appearance and visual character of the areas in which they would be located. Visual changes would result from the construction of various transit infrastructure components such as station entrances, tunnel portals, ancillary support facilities, and traction power equipment. Whether such infrastructure would either impair or enhance the aesthetic quality of the environment depends on the visual characteristics of the affected areas and on the scale, placement, and configuration of the design elements.

To a large extent, the visual contexts that could be altered by the implementation of the proposed alternatives do not yet fully exist. Many areas of the city will undergo dramatic changes in visual character as the CA/T Project and other new developments are realized. City and state agencies, as well as private owners and developers, have been consulted, and current plans, projects, policies, and concepts for the affected areas have been reviewed in order to define this future visual context.

Figure 5-2 is a bird's eye view showing the Piers area and a portion of downtown as they now appear. The downtown area is characterized by a densely-built collection of diverse districts. The seemingly random street and block pattern has evolved over 350 years and today includes areas dominated by newer highrise buildings as well as lower-scaled historic fabric. The elevated Central Artery can be seen cutting through both older and newer districts, creating a strong visual barrier between downtown and the waterfront.

Between downtown and the Piers area is the Fort Point Channel. Once the heart of Boston's industrial waterfront, the channel has historically separated South Boston from Boston Proper, allowing the Piers area and downtown to develop in distinct and contrasting patterns. Directly across the channel from downtown is the Boston Wharf Company area, a collection of nineteenth century warehouse buildings on straight, regular blocks, quite different from the irregularity of the downtown pattern. In even greater contrast to downtown are the large areas of undeveloped land, most of which are presently used for surface parking.

TABLE 5-3: TOTAL ANNUAL TRANSPORTATION SYSTEM ENERGY CONSUMPTION (HIGH GROWTH)

Alternative	Energy Saved by Auto Diversions		Energy Required for Transit Operations (BTU)**		Energy Required for Construction				Total Annual Energy Savings	
					Facilities		Vehicles			
	VMT*	BTU**	Trolleys	Buses	BTU**	30 year amort.	BTU**	12 year amort.	BTU**	Crude Oil Barrels***
Bus/TSM	70.1	438.1	0.0	82.0	255.5	8.5	137.7	11.5	406.2	70.0
MOS-1	86.3	539.1	12.8	66.7	3,799.1	126.6	271.1	22.6	396.9	68.4
MOS-2	86.3	539.4	12.6	66.7	5,220.3	174.0	271.1	22.6	349.7	60.3
Full Build	96.0	600.0	29.8	50.3	8,578.2	285.9	314.4	26.2	303.7	52.4

* VMT (vehicle miles traveled) are in millions
** BTUs (British thermal units) are in billions
*** Barrels are in thousands

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 5-2
Piers Area as It Appears Today

Significant visual features in the Piers area include the elevated roadways of Summer Street and Viaduct Street. Viaduct Street terminates at the second level of Commonwealth Pier which features an historically significant and visually impressive classical facade. Further to the east is BMIP and a portion of the Reserved Channel.

Figure 5-3 is the same view discussed above, but illustrates the major visual changes that are projected to occur, independent of the proposed transit alternatives, between now and the year 2010. The most dramatic changes will take place along the Central Artery corridor and in the Piers area. Other less encompassing changes not visible in the figure will also occur in the Chinatown/Midtown District area and along the Fort Point Channel, including increased commercial and retail development in the Chinatown/Midtown District and establishment of the Harborwalk Park and Esplanade along the Fort Point Channel.

The impact assessment is limited to the permanent impacts that would be experienced upon completion of construction. Although there would be visual impacts during construction, such impacts would be short-term, lasting only as long as the localized construction activity. ***The long-term aesthetic impacts will occur at the Underground Transitway portal, trackless trolley surface routes, and the storage and maintenance facility.***

5.4.1 No Action Alternative

The future development of the Piers area is, to a large extent, contingent upon enhanced public transit service. Clearly, as described in Section 5.2.1.1, a secondary consequence of the No Action Alternative would be less building mass in the Piers area than might otherwise be built in the future.

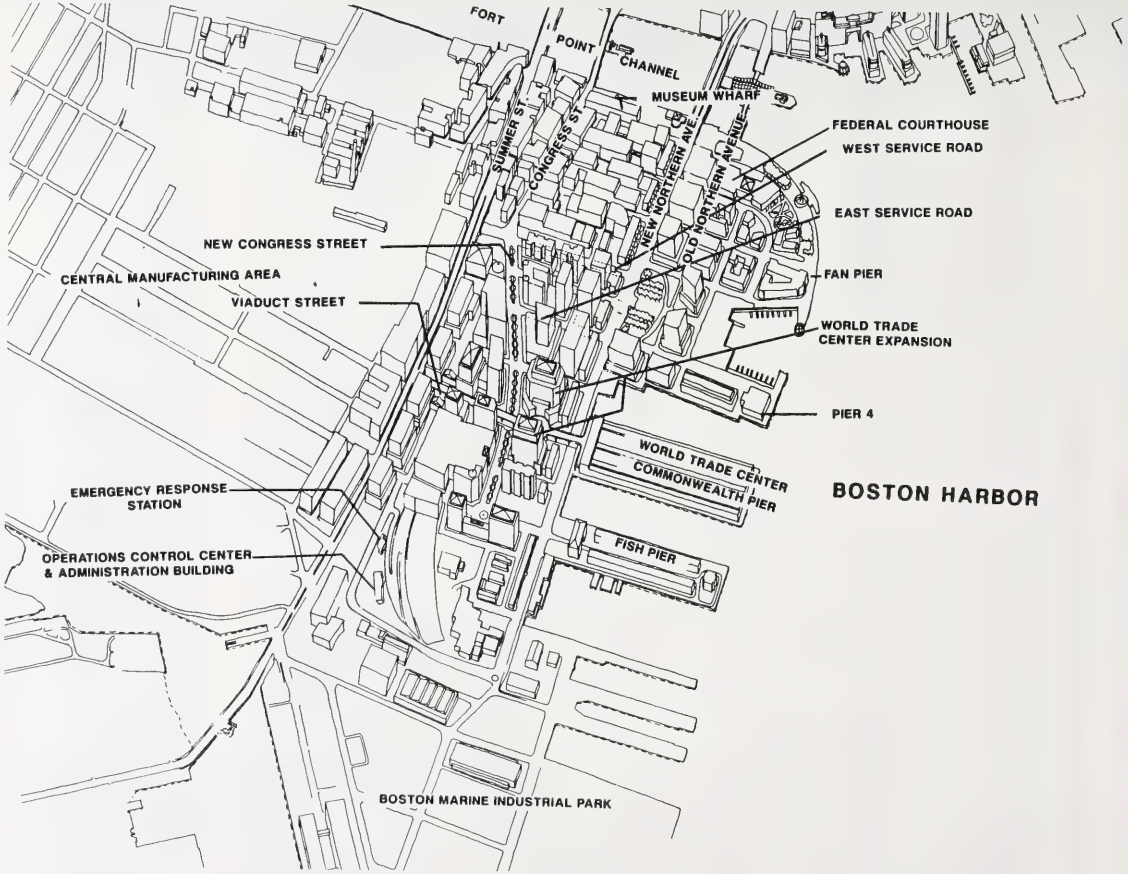
Minor increases in existing bus service occur under the No Action Alternative in response to demand. However, the capital outlays for the alternative are minimal and are limited to augmented routes and additional standard bus shelters, as needed. Visual impacts would be limited to the immediate area around the new bus shelters on sidewalk/street rights-of-way.

5.4.2 Bus/TSM Alternative

Although buses do not cause significant visual impacts, certain elements of the Bus/TSM Alternative would be visible from the street. Visual impacts would occur in three areas: (1) in the area of the surface passenger facilities (Courthouse/Fan Pier, World Trade Center, and Oak Street); (2) along a future extension of Congress Street (New Congress Street); and (3) in the vicinity of the proposed bus storage and maintenance facility.

The Courthouse/Fan Pier and World Trade Center facilities would be of a modest size and consist of an enclosed waiting area, toilet areas, and change/information booths. In addition, pullout lanes would increase load capacity. The visual aspects must conform to and take into account the future growth of the area and must be in context with the urban design program for the streets. Development plans for the McCourt parcel and the Massport expansion plans at the World Trade Center must be taken into account in these station designs. Both stations might be incorporated within buildings being designed and constructed in the area. An unmanned facility would be constructed on Oak Street at the Don Bosco High School. This facility would provide partially enclosed passenger waiting space and would include a two-berth bus pullout. In addition, free-standing shelters and benches would be provided at other bus stops throughout the project area in this alternative.

The bus lane proposed on New Congress Street in the high growth scenario would have a large impact on the BRA's plans for New Congress Street. The proposed boulevard includes a landscaped median. Because the construction of the bus lane would displace curbside parking, the parking replacement mitigation strategy calls for parking in the median of New Congress Street, significantly reducing the area available for landscaping.



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 5-3
South Boston Piers Projected Development (High Growth Scenario)

A storage and maintenance facility for buses operating in this alternative would be required. Such a facility is proposed to be constructed on one of two sites at the Massport Maritime parcel bounded by Summer Street, Pappas Way, West First Street, and E Street. Visual impacts would be minimal and limited to the industrialized area immediately surrounding the facility.

5.4.3 Fort Point Channel Underground Transitway/MOS-1 Alternative

Visual impacts of the MOS-1 Alternative would occur at the portal onto New Northern Avenue, at the Courthouse surface station, and at the storage and maintenance facility located at one of two sites discussed above for the Bus/TSM Alternative. Minimal street-level visual impacts would occur at the South Station kiosks.

An above ground station would be constructed east of the portal near Pittsburgh Street. This station would be similar to small-scale light rail (Green Line) surface stations. It would be free-standing and could be incorporated into future air rights development. The design would be coordinated with the proposed Federal Courthouse development at Fan Pier and the surrounding streetscape.

The most evident impact of the MOS-1 Alternative would be the vehicle portal entry/exit at Pittsburgh Street, as shown in Figure 5-4. This would require sensitive treatment for fencing, lighting, wall texture, signage, and landscaping. A second evident visual impact of trackless trolley technology is the catenary extending from the portal eastward through the Piers area.

The portal to be designed and constructed under the MOS-1 Alternative might be similar to the portal at Harvard Square station. Like the Harvard portal, the MOS-1 design must consider the need to keep errant passenger vehicles from entering the tunnel. The roadway at New Northern Avenue would be interrupted, and the landscaping and other amenities would be somewhat reconfigured with this alternative.

Catenary wires, supports, and other accompanying hardware associated with the operation of trackless trolleys must be considered and accommodated. These could be intrusive on a boulevard type street such as that proposed for both New Northern Avenue and New Congress Street. Mitigating design techniques would include the incorporation of catenary supports in the design of street lights and traffic control masts.

The MOS-1 Alternative would utilize the proposed northbound Central Artery tunnel alignment under Atlantic Avenue and would create a new Transitway station over the existing Red Line platforms at South Station. This would allow a central lobby and vertical circulation elements to serve both the new and existing stations. The lobby, which would be one level below the existing street, could also be used as a pedestrian underpass connecting all four corners of the Atlantic Avenue/Summer Street intersection. Visual impacts due to stairways and escalators at this intersection, including One Financial Center and the Federal Reserve Plaza, would be slight, consisting only of the relocation of one existing entrance and one proposed entrance kiosk.

The MOS-1 Alternative would require a bus storage and maintenance facility in the Piers area. This facility must be screened with adequate landscaping and fencing in order to blend in with the overall image being portrayed, with particular attention paid to screening the catenary installation in the facility. Both sites on the Massport Maritime parcel are adequate in size to provide such screening. The height of the building would be approximately 30 feet (not including surface parking at Site B) and should be designed to blend with the new buildings being proposed for the district. Its roofscape must be designed to be compatible with the general landscape as seen from the surrounding higher buildings.

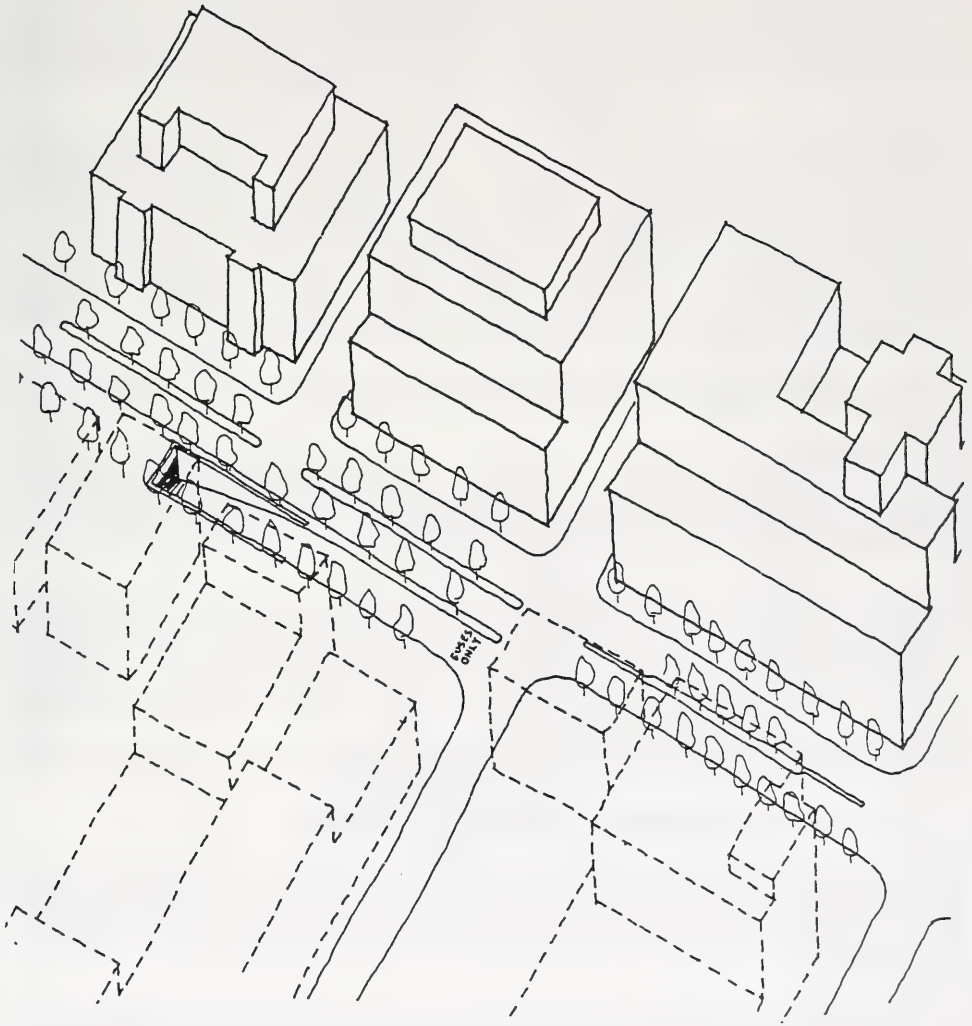
5.4.4 Fort Point Channel Underground Transitway/MOS-2 Alternative

Visual impacts of the MOS-2 Alternative would occur at the World Trade Center Station, Courthouse Station, South Station, at the site of the proposed storage and maintenance facility, and along the surface routes in the eastern Piers/BMIP area.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 5–4
Transitway Portal
at Pittsburgh Street



Inherent in the trackless trolley technology is the overhead catenary system with its supports and power supply. Much of the surface routing proposed is a one-way system and can utilize a cantilevered catenary element (see Figure 5-5). Appropriate design of these elements incorporated into the streetscape can enhance the visual impact. Mitigating design measures might include cantilever arrangements for the catenary portions as well as incorporating lighting, signage, and other streetscape elements within the support system. The catenary itself can be designed to become a geometric pattern and be coordinated with the lighting, landscaping, and signage for the above ground portions. The vertical supports for the system can be coordinated with the design of the street elements and become part of the decorative urban design fabric of the proposed streetscape; they could also be incorporated into the design of the bus stops and signage. The MBTA is currently working with the South Boston Interagency Streetscape Task Force to integrate surface elements of the Transitway into the future streetscape design for the area.

The proposed Courthouse Station would be located beneath New Northern Avenue between Pittsburgh and Farnsworth Streets. Station elements would include a stairway and escalator on each side of the avenue. The entrance on the northern side of the avenue could be incorporated into the ground floor of a future building within the block between Pittsburgh and Farnsworth Streets, thereby keeping pedestrian views along the avenue free and unobstructed. Station elements on the south side of New Northern Avenue would likely include freestanding kiosks, with a stairway/escalator and an elevator for handicapped access. Also visible would be a low vent shaft which could be visually softened with landscaping. The station elements would present a minor visual presence in the overall streetscape and would not interfere significantly with views down New Northern Avenue towards the downtown skyline.

The portal to grade at the World Trade Center would be a part of Massport's parking garage and would be located on the southerly side of the structure, as shown in Figure 5-6.

A new station serving the World Trade Center expansion project would be located beneath the area south of New Congress Street and east of Viaduct Street. This facility would be enclosed within Massport's proposed Replacement Parking Garage and would be accessible from New Congress and Viaduct Streets. Visual impacts of the station would be limited to the integration of the station's surface level entrances and exits into the design of the adjacent structure.

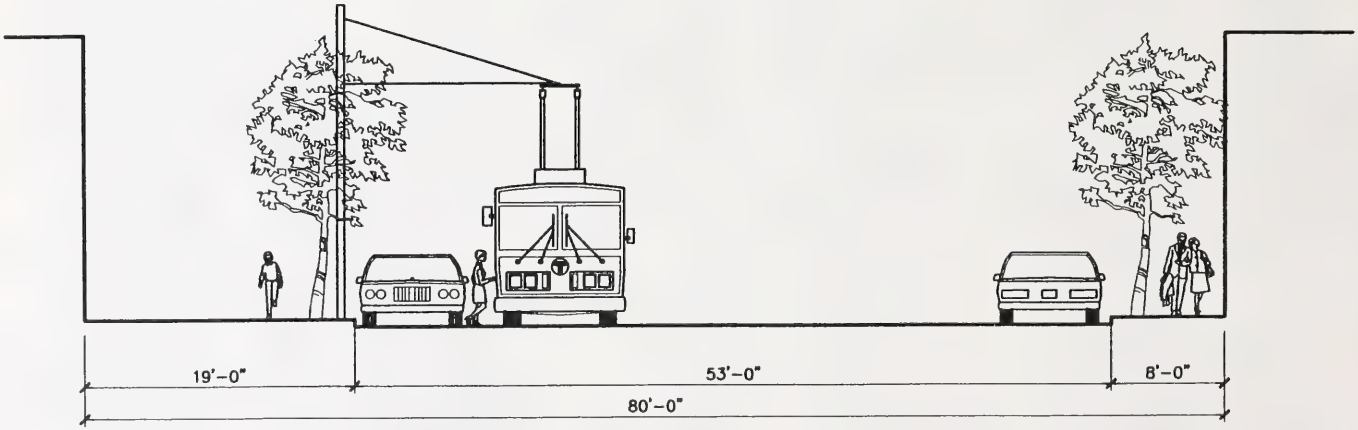
The Transitway would surface and intersect at D Street with a connection to the maintenance facility. While trackless trolley catenary impacts would be evident at the D Street portal, they will be substantially reduced as compared to the MOS-1 Alternative because of the extended underground alignment between Courthouse/Fan Pier and the World Trade Center. ***Design treatment of both the portal and the overhead catenary at intersections throughout the Piers area would further reduce these impacts.***

The visual impacts of the MOS-2 Alternative at South Station and of a storage and maintenance facility would be minimal and the same as those described for the MOS-1 Alternative in Section 5.4.3.

5.4.5 Fort Point Channel Underground Transitway/Full Build Alternative

Given its fully underground alignment, the visual and aesthetic impacts of the Full Build Alternative would be limited to specific sites along the alignment where station elements penetrate to street level (or where subsurface construction occurs beneath existing buildings or parcels). Station elements that penetrate to street level and that could cause visual impacts include entrances to stairways and escalators, elevators, and ventilation shafts.

Visual impacts in the Piers area would be minimal and the same as those described for the MOS-2 Alternative in Section 5.4.4. ***Transitway routing within the South Boston mixed industrial/commercial/ residential areas will be mitigated utilizing design devices described for the MOS-2 Alternative, including the integration and coordination of the supports and hardware for the catenary system. At the West Broadway and First Street portions of the surface route, street trees as well as coordination with the street lighting and signage would mitigate the visual impacts of the***



TYPICAL STREET SECTION

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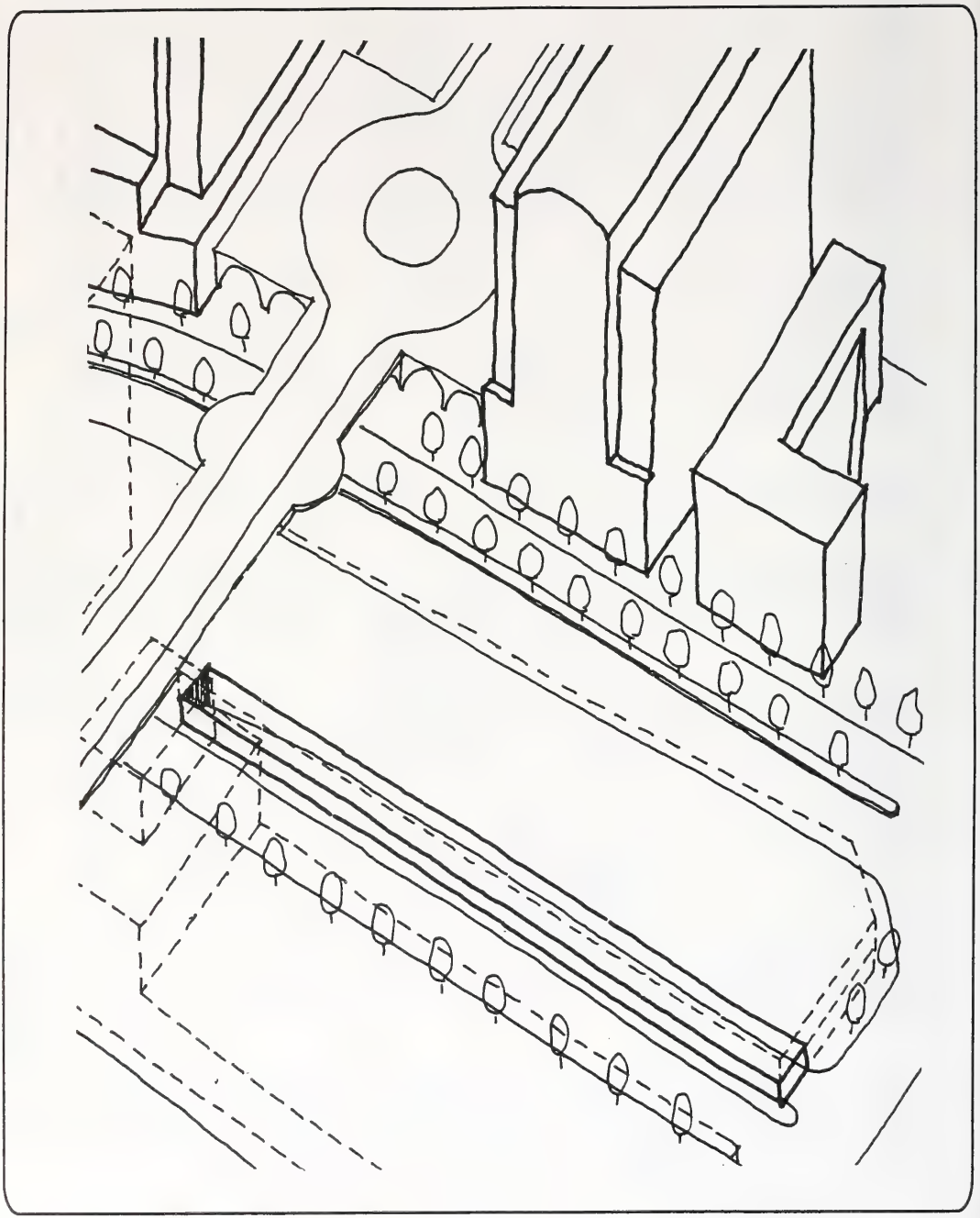
South Boston Piers/ Fort Point Channel Transit Project

Fig. 5-5
Streetscape Section

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 5-6
World Trade Center
Portal
Cut-Away View



cantilevered catenary on the street. However, as technology advances are made in meeting the standards mandated by the Clean Air Act Amendments, the likelihood of using the catenary system in the Full Build configuration would be low. Rather, new vehicle technologies such as battery powered buses, would likely be available for the extension of the surface routes into South Boston in 2008.

The Full Build Alternative provides for the construction of the Underground Transitway from the World Trade Center to South Station and then northwards to Boylston Station, with an intermediate station at Chinatown. For the segment from South Station to Boylston Station, most of the tunnel alignment and all of the proposed stations would be located beneath existing or future streets, thus minimizing visual impacts on parcels and buildings. Any visual impacts resulting from construction activity would be fully mitigated and of only short-term duration.

5.5 AIR QUALITY IMPACTS

The U.S. Environmental Protection Agency (EPA) has classified the entire Commonwealth of Massachusetts as a serious nonattainment area for ozone. The immediate Boston vicinity, including the project area, has also been classified as a moderate carbon monoxide (CO) nonattainment area (design concentration $\leq$ 12.7 parts per million, 56 Federal Register 56693, November 6, 1991). The Commonwealth has made repeated attempts to achieve the Massachusetts and National Ambient Air Quality Standards (NAAQS) for ozone and CO in the past through development of modifications to its State Implementation Plan (SIP) and implementation of a wide range of programs. However, this continuing effort has so far been unsuccessful.

The passage of the Clean Air Act Amendments of 1990 (CAAA) initiated a new strategy for achieving the NAAQS in areas that have failed to do so in the past. The CAAA mandated that states revise their SIPs by November 1993. For areas classified as serious nonattainment for ozone, the Act allows nine years for attainment of the NAAQS. However, as part of their SIP revisions, states must document how two specific requirements of the Act will be met — one calling for a 15 percent reduction in total volatile organic compound (VOC) emissions by 1996 and an additional 3 percent per year reduction for 1997 through 1999. Both reductions are to be determined net of area growth.

VOCs represent a wide array of organic compounds that act as ozone precursors, reacting chemically in sunlight (in combination with other gases) to form ozone. The baseline for determining sources and reduction levels will be an areawide emissions inventory. Measures and programs to achieve the VOC reductions must be identified by November 1993. Other CAAA provisions for achieving the ozone NAAQS applicable to serious nonattainment areas are concerned with motor vehicle inspection/maintenance programs, service station vapor recovery systems, clean fuel vehicle programs for centrally fueled fleets, and development of contingency programs that will take effect automatically if a state fails to make an emissions reduction target.

In regard to attaining the CO standard in moderate nonattainment areas, the CAAA specifies a target date of December 31, 1995. During winter months, 2.7 percent oxygenated fuel will be required within the consolidated metropolitan statistical area (CMSA).

Planning for the MHD's CA/T Project in Boston has involved ten years of environmental analyses, including evaluations of air quality impacts. The South Boston Piers Transit Project has been planned with the CA/T Project as a backdrop. For this reason, it was appropriate to adopt some of the modeling assumptions used in the previous CA/T Project air quality analysis (MHD, 1990) as part of the present MBTA analysis. For example, the base year (1987) and design year (2010) of the two projects are identical, and traffic data used in the CA/T Project analyses formed the core of the transit project traffic studies. For purposes of the air quality analysis, data and technical assumptions borrowed from the CA/T Project analysis are described in the appropriate subsections below.

5.5.1 Microscale Impacts

The microscale analysis is the component of the overall air quality impact assessment that focuses on localized (rather than regional) changes in ambient air quality conditions that may occur with implementation of the various project alternatives. The pollutant parameter used in this analysis is CO, a primary pollutant whose major source is transportation exhaust emissions. It is also a pollutant for which ambient air quality standards have been promulgated as follows:

- 35.0 parts per million (ppm) for a one-hour averaging period, not to be exceeded more than once per year
- 9.0 ppm for a consecutive eight-hour averaging period, not to be exceeded more than once per year

The goal of the microscale analysis is to determine whether changes in roadway design and travel patterns associated with the proposed project would interfere with efforts to attain or maintain these standards.

5.5.1.1 Modeling Site Selection

Localized traffic congestion created or exacerbated by mass transit projects can have major air quality implications and is usually a more important consideration than the direct emissions of the mass transit vehicles themselves. As mentioned in the introduction to this chapter, increased congestion can be caused by larger numbers of mass transit vehicles (buses and trackless trolleys) operating on existing routes or added to new routes, as well as by changes in commuting patterns made for purposes of connecting to or avoiding new transit routes. The consequences of traffic congestion — low travel speeds, extended idling and repeated short cycles of acceleration/deceleration — also represent some of the conditions under which vehicles emit the highest rates of CO in their exhaust.

In urban areas, the greatest congestion occurs primarily at intersections where slow-moving vehicles, in combination with vehicles forced to idle in queues for extended periods, can release sufficient amounts of CO to generate a hot spot — a localized exceedance of air quality standards (Central Transportation Planning Staff, 1981). Because busy intersections can be sites of the greatest changes, both beneficial and adverse, in ambient air quality conditions upon implementation of transit or roadway improvements, they are often the major focus of microscale investigations.

For these reasons, traffic projections and level of service (LOS) evaluations at 25 intersections located throughout the study area were examined as the principal screening tool for selecting air quality analysis sites. In consultation with DEP and the EPA, it was determined that the initial screening criteria to be used to identify potential sites would consist of the following:

- Traffic volumes at an intersection must be equivalent to LOS D plus 10 percent under any action alternative, and
- The intersection must experience a worse LOS under an action alternative than under the No Action Alternative.

Upon analysis of traffic projections, intersection delays, and levels of service, however, none of the 25 intersections met these criteria.

These results were discussed at another meeting held with DEP and EPA representatives. In reviewing LOS projections, five intersections were identified that would experience sufficient delay and congestion to potentially represent an air quality problem area, even though they were operationally better than the initial screening criteria. These intersections included:

- Atlantic Avenue/Congress Street
- New Northern Avenue/East Service Road
- Congress Street/East Service Road
- Summer Street/D Street
- Massport Haul Road/D Street

As a result, it was determined that a detailed microscale analysis should be performed at each of these sites. The locations of these intersections are shown in Figure 5-7. ***However, since three of these intersections did not exist in the base year of 1987 (New Northern Avenue/East Service Road, Congress Street/East Service Road and Massport Haul Road/D Street), the base year microscale analysis was confined to the two remaining intersections. (It should also be noted that one of these intersections, Summer Street/D Street, will undergo a significant change in configuration in the future as a result of the CA/T Project. This consideration will be discussed further in Section 5.5.1.3).***

5.5.1.2 Models and Modeling Assumptions

Two types of models are required to perform a microscale analysis and to get the information needed to complete a mesoscale analysis. An emissions model is used to determine the rates at which pollutants are being released by motor vehicles, while a dispersion model evaluates how the pollutants are mixed with other constituents once released into the atmosphere and dispersed from the release site. For this analysis, the emissions model MOBILE 4.1 was used to calculate vehicular emission rates (EPA, 1991). The dispersion model used to calculate pollutant concentrations at specific sites under various assumptions of worst case conditions was CAL3QHC (EPA, 1990). The CAL3QHC model combines the dispersion model CALINE3, which is applicable to roadways having freely-flowing traffic, with an algorithm for calculating emissions from vehicles under interrupted flow conditions, the situation that prevails on most urban streets. The model can be used to determine pollutant concentrations near intersections by accounting for the emissions of both freely-flowing vehicles and vehicles idling in queues at traffic signals. CAL3QHC can also be utilized for roadways with strictly freely flowing traffic by specifying values for certain parameters that cause the model to bypass the queuing algorithm and result in the model functioning identically to CALINE3.

Exceedances of the CO standard in Massachusetts have involved the eight-hour standard rather than the one hour standard. Consequently, the microscale analysis for this project involved a detailed evaluation of air quality impacts for the worst consecutive eight-hour period of the day in terms of specific traffic volumes. To determine whether the one-hour standard might also be exceeded, a persistence factor of 0.6 was applied to the results of the eight-hour analysis. This factor was used in the air quality analysis for the CA/T Project and was derived from DEP monitoring data collected in the Boston area during 1986, 1987, and 1988. DEP concurred that this persistence factor remains valid for the current analysis.

5.5.1.3 Results

Base Year 1987

The microscale analysis results for the base year for the two intersections evaluated are presented in Table 5-4. Results are shown for three receptor locations associated with the Atlantic Avenue/Congress Street intersection and four receptor locations associated with the Summer Street/D Street intersection. For each receptor site, the wind angle producing the worst case CO concentration is listed, followed by the predicted worst case one-hour and eight-hour CO concentrations. The CO values include background concentrations of 5.0 ppm (one hour) and 3.0 ppm (eight hour). In comparing these results to the appropriate National and Massachusetts Ambient Air Quality Standards, it can be seen that no violations of either the 35.0 ppm one-hour CO standard or the 9.0 ppm eight-hour CO standard were predicted to occur in the base year at the Summer Street/D Street intersection. However, while no violations of the one-hour standard were predicted at the Atlantic Avenue/Congress Street intersection, violations of the eight-hour standard were

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South Boston Piers/ Fort Point Channel Transit Project

Fig. 5-7
Air Quality
Traffic Impact Analysis
Intersections

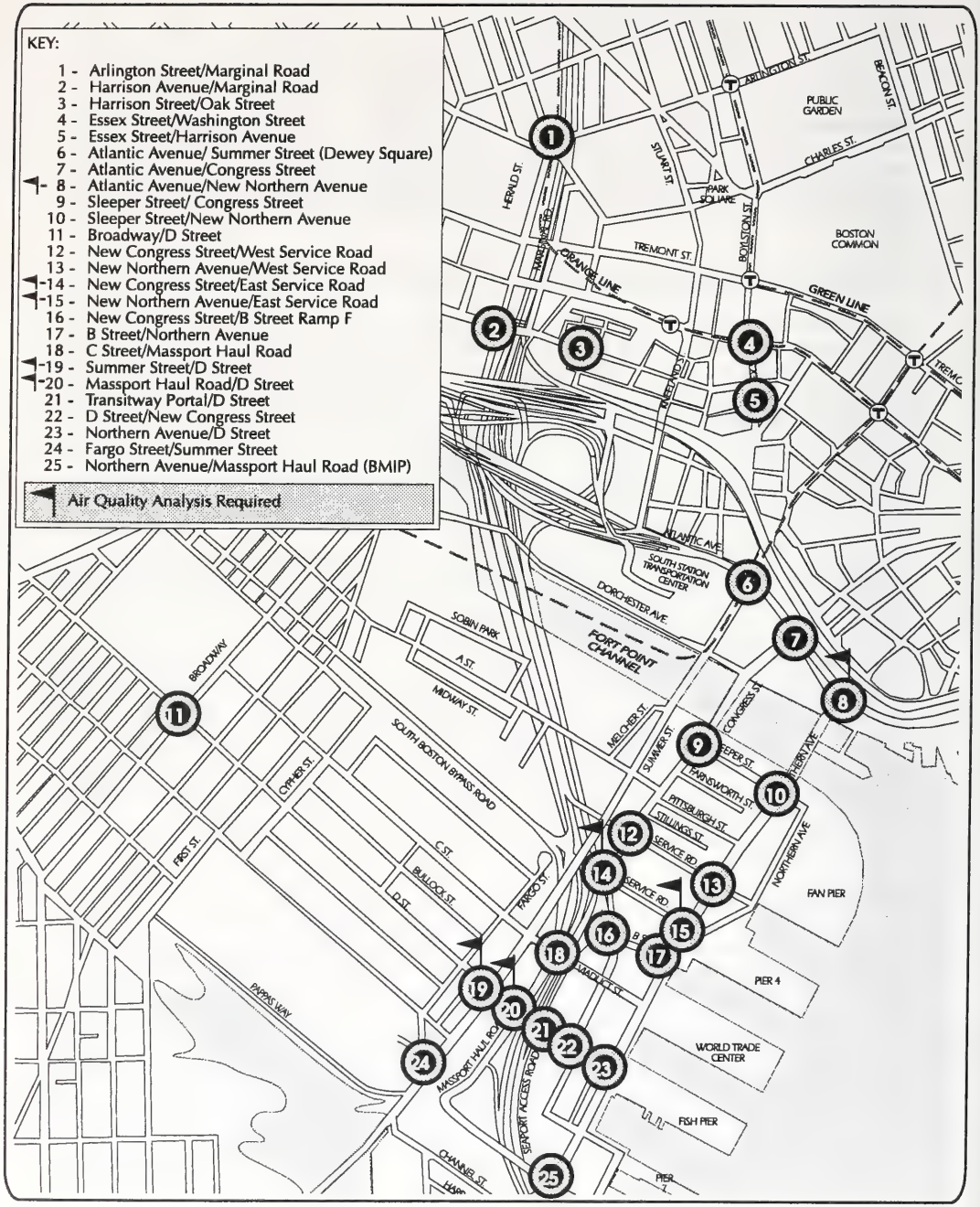

TABLE 5-4: ESTIMATED WORST CASE 1987 ONE-HOUR AND EIGHT-HOUR CO CONCENTRATIONS*

Intersection	Receptor Location	Worst Case Wind Angle (degrees)	One Hour CO Concentration	Eight Hour CO Concentration
Atlantic Avenue/ Congress Street	NW Corner	130	22.0	13.2
	SW Corner	350	17.3	10.4
	SE Corner	250	20.8	12.5
Summer Street/ D Street	NW Corner	200	9.7	5.8
	NE Corner	250	10.0	6.0
	SW Corner	120	10.7	6.4
	SE Corner	320	12.8	7.7

* CO concentrations are expressed in parts per million (ppm) and include a background concentration of 5.0 ppm (one hour) and 3.0 ppm (eight hour).

predicted to occur at each of the three receptor locations under worst case conditions. This outcome is in keeping with the longstanding recognition of this intersection as a CO hot spot.

Opening Year (2000)

The results of the CO microscale analysis for project alternatives for the opening year are presented in Tables 5-5 and 5-6. This analysis is based on the high growth scenario and can be construed to represent a "worst case" for microscale air quality impacts. Table 5-5 presents the results of the eight-hour analysis for each project alternative, including worst case CO concentrations at each receptor location and the wind angle producing the highest CO concentration. In comparing these results to the national and Massachusetts eight-hour CO standard of 9.0 ppm, it can be seen that no exceedances are expected to occur at any receptor location under any alternative. Table 5-6 presents the estimated worst case one-hour CO concentrations for all alternatives at these same receptor locations. Once again, in comparing the one-hour results with the national and Massachusetts one-hour CO standard of 35.0 ppm, there would be no exceedances of the standard even under the worst case conditions assumed as part of this analysis.

Design Year (2010)

The microscale analysis results for project alternatives in the year 2010 are summarized in Tables 5-7 and 5-8. This analysis is based on the high growth scenario and can be construed to represent a "worst case" for air quality impacts. Table 5-7 lists the predicted worst case eight-hour CO concentrations at all receptor locations along with the wind angle producing the indicated highest concentration. Table 5-8 presents the estimated worst case one-hour CO concentrations at the same receptor locations. Similar to the opening year modeling results, the 2010 results indicate that there would be no exceedances of the one-hour or eight-hour CO standards under worst case conditions. Because of the assumptions used in the analysis, no exceedances of the CO standards are expected to occur in the design year under the No Action Alternative or with implementation of any of the action alternatives.

TABLE 5-5: ESTIMATED OPENING YEAR WORST CASE EIGHT-HOUR CO CONCENTRATIONS

		Alternative							
		No Action		Bus/TSM		MOS		Full Build	
Intersection	Receptor Location	Wind Angle	CO Conc.	Wind Angle	CO Conc.	Wind Angle	CO Conc.	Wind Angle	CO Conc.
Atlantic Avenue/ Congress Street	NW Corner	10	6.1	10	6.0	10	6.0	10	6.1
	SW Corner	340	6.9	340	6.5	340	6.1	340	6.6
	SE Corner	240	6.3	240	6.2	240	6.2	240	6.2
New Northern Avenue/ East Service Road	NW Corner	110	4.7	110	3.7	120	3.2	120	3.1
	NE Corner	250	4.6	240	3.9	240	3.5	240	3.4
	SW Corner	10	3.7	0	3.4	10	3.1	0	3.2
	SE Corner	290	3.0	290	2.8	290	2.7	290	2.7
Congress Street/ East Service Road	NW Corner	80	5.1	80	4.6	90	4.3	90	4.2
	NE Corner	220	4.0	210	3.6	210	3.5	200	3.4
	SW Corner	10	4.1	0	3.8	0	3.6	0	3.6
	SE Corner	340	3.9	270	3.4	260	3.3	330	3.4
Summer Street/ D Street	NW Corner	140	5.5	140	5.3	140	5.3	140	5.7
	NE Corner	20	6.1	10	5.7	10	5.8	10	5.8
	SW Corner	50	6.5	50	6.3	50	6.3	50	6.4
	SE Corner	20	6.0	20	5.9	20	5.9	20	6.2
Massport Haul Road/ D Street	NW Corner	200	6.0	200	5.7	200	5.9	190	5.5
	NE Corner	240	5.2	240	5.0	240	5.1	240	5.2
	SW Corner	140	5.2	140	5.0	140	5.1	140	4.9
	SE Corner	270	6.5	270	6.4	270	6.6	270	6.4

* *CO concentrations are expressed in parts per million (ppm) and include a background concentration of 1.8 ppm; wind angles are shown in degrees.*

TABLE 5-6: ESTIMATED OPENING YEAR WORST CASE ONE-HOUR CO CONCENTRATIONS

		ALTERNATIVE			
		No Action	Bus/TSM	MOS	Full Build
Intersection	Receptor Location	CO Conc.	CO Conc.	CO Conc.	CO Conc.
Atlantic Avenue/ Congress Street	NW Corner	10.2	10.0	10.0	10.2
	SW Corner	11.5	10.8	10.2	11.0
	SE Corner	10.5	10.3	10.3	10.3
New Northern Avenue/ East Service Road	NW Corner	7.8	6.2	5.3	5.2
	NE Corner	7.7	6.5	5.8	5.7
	SW Corner	6.2	5.7	5.2	5.3
	SE Corner	5.0	4.7	4.5	4.5
Congress Street/ East Service Road	NW Corner	8.5	7.7	7.2	7.0
	NE Corner	6.7	6.0	5.8	5.7
	SW Corner	6.8	6.3	6.0	6.0
	SE Corner	6.5	5.7	5.5	5.7
Summer Street/ D Street	NW Corner	9.2	8.8	8.8	9.5
	NE Corner	10.2	9.5	9.7	9.7
	SW Corner	10.8	10.5	10.5	10.7
	SE Corner	10.0	9.8	9.8	10.3
Massport Haul Road/ D Street	NW Corner	10.0	9.5	9.8	9.2
	NE Corner	8.7	8.3	8.5	8.7
	SW Corner	8.7	8.3	8.5	8.2
	SE Corner	10.8	10.7	11.0	10.7

* *CO concentrations are expressed in parts per million (ppm) and include a background concentration of 3.0 ppm.*

TABLE 5-7: ESTIMATED 2010 WORST CASE EIGHT-HOUR CO CONCENTRATIONS*

Intersection	Receptor Location	ALTERNATIVE							
		No Action		Bus/TSM		MOS		Full Build	
		Wind Angle	CO Conc.	Wind Angle	CO Conc.	Wind Angle	CO Conc.	Wind Angle	CO Conc.
Atlantic Avenue/ Congress Street	NW Corner	130	5.2	130	5.0	130	4.9	130	5.0
	SW Corner	340	5.1	350	4.7	340	5.1	340	5.0
	SE Corner	240	5.9	240	5.6	260	5.4	240	5.5
New Northern Avenue/ East Service Road	NW Corner	100	5.2	110	4.6	100	4.0	100	4.0
	NE Corner	250	5.4	250	4.2	250	3.4	250	4.6
	SW Corner	0	4.2	0	3.6	20	3.6	32	3.5
	SE Corner	290	3.4	350	3.0	290	3.0	330	3.0
Congress Street/ East Service Road	NW Corner	80	4.5	80	4.4	80	4.2	80	4.2
	NE Corner	200	3.8	240	3.6	220	3.5	230	3.4
	SW Corner	10	4.1	10	3.6	10	3.5	0	3.5
	SE Corner	340	4.2	340	3.7	340	3.6	340	3.4
Summer Street/ D Street	NW Corner	130	5.7	140	5.6	130	5.9	140	5.9
	NE Corner	10	6.3	270	6.4	270	6.7	0	6.4
	SW Corner	50	6.7	50	6.5	60	6.9	50	6.7
	SE Corner	20	6.2	20	6.6	20	7.4	20	6.8
Massport Haul Road/ D Street	NW Corner	200	5.7	200	5.6	200	5.9	200	5.7
	NE Corner	250	5.2	240	5.2	240	5.4	240	5.3
	SW Corner	180	5.1	180	5.1	180	5.5	180	5.4
	SE Corner	260	6.4	250	6.5	260	6.7	250	6.4

* CO concentrations are expressed in parts per million (ppm) and include a background concentration of 1.7 ppm; wind angles are shown in degrees. 8-hour NAAQS is 9 ppm.

TABLE 5-8: ESTIMATED 2010 WORST CASE ONE-HOUR CO CONCENTRATIONS*

		Alternative			
		No Action	Bus/TSM	MOS	Full Build
Intersection	Receptor Location	CO Conc.	CO Conc.	CO Conc.	CO Conc.
Atlantic Avenue/ Congress Street	NW Corner	8.7	8.3	8.2	8.3
	SW Corner	8.5	7.8	8.5	8.3
	SE Corner	9.0	9.3	9.0	9.2
New Northern Avenue/ East Service Road	NW Corner	8.7	7.7	6.7	6.7
	NE Corner	9.0	7.8	5.7	7.7
	SW Corner	7.0	6.0	6.0	5.8
	SE Corner	5.7	5.0	5.0	5.0
Congress Street/ East Service Road	NW Corner	7.5	7.3	7.0	7.0
	NE Corner	6.3	6.0	5.8	5.7
	SW Corner	6.8	6.0	5.8	5.8
	SE Corner	7.0	6.2	6.0	5.7
Summer Street/ D Street	NW Corner	9.5	9.3	9.8	9.8
	NE Corner	10.5	10.7	11.2	10.7
	SW Corner	11.2	10.8	11.5	11.2
	SE Corner	10.3	11.0	12.3	11.3
Massport Haul Road/ D Street	NW Corner	9.5	9.3	9.8	9.5
	NE Corner	8.7	8.7	9.0	8.8
	SW Corner	8.5	8.5	9.2	9.0
	SE Corner	10.7	10.8	11.2	10.7

* CO concentrations are expressed in parts per million (ppm) and include a background concentration of 2.8 ppm.

5.5.2 Mesoscale Impacts

The purpose of the mesoscale analysis is to provide relative indications of the regional air quality impacts of the various project alternatives. This approach provides recognition of the fact that a project alternative may generate both positive and negative impacts in areas removed from the immediate project locale. The mesoscale analysis permits comparisons among project alternatives of the effects on regional travel patterns and the resulting implications for vehicular emissions and total atmospheric loadings of CO, NMHC, and NO_x. To accomplish this, separate calculations of total daily VMT were made for the opening year and design year reflecting both the lower and high growth scenarios.

Projections of regional VMT for the base year and for each project alternative in the opening and design years were obtained from the Central Transportation Planning Staff (CTPS) and are presented in Table 5-9. The boundaries of the region evaluated as part of this analysis are depicted in Figure 5-8. The VMT data represent:

- All trips that originate and terminate within the indicated region;
- All trips that originate outside the region and terminate within the region;
- All trips that originate within the region and terminate outside the region; and
- All trips that originate and terminate outside the region but pass through the region enroute to other destinations.

Trips by all vehicle types, including buses, trucks, and taxis, are included in the VMT data. In addition to these data, the mesoscale analysis requires an estimate of the average speed of vehicles on the roadway network in each year of analysis. The average network speeds developed by CTPS for this project were:

- 1987 - 31.1 mph
- 2000 - 30.4 mph
- 2010 - 28.7 mph

These values serve as input to MOBILE4.1 to generate the emission factors for CO, NMHC, and NO_x mentioned previously.

The product of these emission factors and VMT, summed across all vehicle classifications and converted to units of tons per day, results in the total daily regional atmospheric loadings from mobile sources of CO, NMHC, and NO_x presented in Table 5-9. Estimated loadings are shown for the base year and for each of the four project alternatives in the opening year and design year. In Table 5-10, the change in total atmospheric loadings of each pollutant between the base year and future year under each build alternative is shown. It can be seen that all of the build alternatives would result in reduced regional loadings of CO, NMHC, and NO_x when compared to the base year.

In general, for any transportation project, comparison of regional atmospheric loadings under future build alternatives with base year loadings is necessary to demonstrate that the project will contribute to the achievement and maintenance of air quality standards. However, in the case of the South Boston Piers Transit Project, such comparison, by themselves, may not conclusively demonstrate that future air quality conditions would improve with project construction. This is due to the circumstances imposed by the parallel implementation of the CA/T Project. Atmospheric loadings under future year South Boston Piers Transit "build" alternatives should be compared to the loadings predicted for the No Action Alternative for the same future year, since the No Action Alternative already represents the future year "build" condition of the CA/T Project. The CA/T Project has already been determined to provide a significant improvement in future air quality conditions versus base year conditions. Any South Boston Piers Transit Project "build" alternative that would provide a lower emissions burden than the No Action Alternative, would demonstrate both an improvement over base year conditions and an enhancement in future year ambient air quality over conditions that are expected to occur solely with implementation of the CA/T Project. These comparisons are also presented in Table 5-10.

TABLE 5-9: REGIONAL DAILY VMT

Base Year 1987:

Vehicle Classification	Daily VMT
Motorcycles	342,965
Light duty gas vehicles	66,706,654
Light duty gas trucks <6000 lbs	9,345,791
Medium duty gas trucks, 6000-8500 lbs	1,731,972
Heavy duty gas trucks, 8500 lbs +	248,649
Light duty diesel vehicles	2,229,271
Light & medium duty diesel trucks, 0-8500 lbs	3,343,907
Heavy duty diesel trucks, 8500 lbs +	1,791,991
TOTAL VMT	85,741,200

Opening Year 2000 (By Alternative):

Vehicle Classification	No Action	Bus/TSM	MOS	Full Build
Motorcycles	283,118	282,769	282,665	282,587
Light duty gas vehicles	73,422,048	73,331,411	73,304,570	73,284,264
Light duty gas trucks, <6000 lbs	10,588,630	10,575,558	10,571,687	10,568,759
Med. duty gas trucks, 6000-8500 lbs	1,906,331	1,906,331	1,906,331	1,906,331
Heavy duty gas trucks, 8500 lbs+	9,437	9,437	9,437	9,437
Light duty diesel vehicles	2,453,693	2,450,664	2,449,767	2,449,089
Light/Med duty diesel trucks, 0-8500 lbs	3,727,726	3,725,513	3,724,857	3,724,361
Heavy duty diesel trucks, 8500 lbs+	1,981,829	1,981,829	1,981,829	1,981,829
TOTAL	94,372,813	94,261,124	94,228,049	94,203,027

TABLE 5-9: REGIONAL DAILY VMT* (continued)

Design Year 2010 (By Alternative):

Vehicle Classification	No Action	Bus/TSM	MOS	Full Build
Motorcycles	292,313	291,601	291,436	291,338
Light duty gas vehicles	75,806,375	75,621,911	75,579,121	75,553,603
Light duty gas trucks, <6000 lbs	10,932,488	10,905,885	10,899,714	10,896,034
Med. duty gas trucks, 6000-8500 lbs	1,968,238	1,968,238	1,968,238	1,968,238
Heavy duty gas trucks, 8500 lbs+	9,744	9,744	9,744	9,744
Light duty diesel vehicles	2,533,375	2,527,210	2,525,780	2,524,928
Light-Med. duty diesel trucks, 0-8500 lbs	3,848,781	3,844,276	3,843,231	3,842,608
Heavy duty diesel trucks, 8500 lbs+	2,046,188	2,046,188	2,046,188	2,046,188
TOTAL	97,437,500	97,210,192	97,157,464	97,126,018

* Source: Central Transportation Planning Staff.

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South Boston Piers/ Fort Point Channel Transit Project

Fig. 5-8
Region Included In Mesoscale Air Quality Analysis

Boston Metropolitan Area
(775 Zones)

TABLE 5-10: ESTIMATED REGIONAL DAILY ATMOSPHERIC LOADINGS OF POLLUTANTS FROM VEHICULAR EMISSIONS

Year	Alternative	Pollutant Burden (tons per day)		
		CO	NMHC	NO_x
1987	---	2454.39	339.67	197.39
2000	No Action	955.35	107.94	83.13
	Bus/TSM	954.23	107.82	83.06
	MOS	953.89	107.78	83.04
	Full Build	953.64	107.76	83.02
2010	No Action	849.68	106.14	76.21
	Bus/TSM	847.73	105.90	76.07
	MOS	847.27	105.84	76.04
	Full Build	847.00	105.81	76.02

TABLE 5-11: COMPARISON OF DAILY REGIONAL POLLUTANT BURDENS UNDER EACH BUILD ALTERNATIVE WITH THE BASE YEAR AND NO ACTION ALTERNATIVE

Year	Build Alternative	CO (tons per day)		NMHC (tons per day)		NO_x (tons per day)	
		Change from Base Year	Change from No Action	Change from Base Year	Change from No Action	Change from Base Year	Change from No Action
2000	Bus/TSM	-1500.16	-1.12	-231.85	-0.13	-114.33	-0.07
	MOS	-1500.50	-1.46	-231.89	-0.16	-114.35	-0.09
	Full Build	-1500.75	-1.71	-231.91	-0.18	-114.37	-0.11
2010	Bus/TSM	-1606.66	-1.95	-233.77	-0.24	-121.32	-0.14
	MOS	-1607.12	-2.41	-233.83	-0.30	-121.35	-0.17
	Full Build	-1607.39	-2.68	-233.86	-0.33	-121.37	-0.19

The results of the mesoscale analysis indicate that any of the build alternatives would result in decreased atmospheric loadings of all three pollutant parameters over loadings that would occur if this project were not constructed. While these reductions would be comparatively small, they nonetheless represent reductions in total regional emissions beyond the reductions expected to result from completion of the CA/T Project. The smallest reduction would be associated with the Bus/TSM Alternative, with a slightly greater reduction occurring under the MOS Alternatives. The greatest level of reduction would occur under the Full Build Alternative although, in absolute terms, the reduction would represent only a very small portion of the total transportation-related loadings of these pollutants.

5.5.3 Implications for Local and Regional Air Quality Planning

The proposed transit improvements have been recognized for several years by local and regional planners as a key element in the planning for transportation facilities to serve the projected extensive development of the South Boston Piers area. Recently, Massachusetts adopted a change in its air pollution control regulations by inserting a new subsection 7.36 in 310 CMR entitled "Transit System Improvements." This subsection committed the Commonwealth to implementation of a specified set of transit improvements by certain dates including the proposed South Boston Piers Transit Project.

The following conclusions can be drawn based on the foregoing analysis:

- All project alternatives would result in decreased regional emissions of CO, NMHC, and NO_x over the base year and over the No Action Alternative in the opening and design years, and none of these alternatives would interfere with implementation of any approved transportation control measures from the existing SIP;

- Although the project is located in a CO nonattainment area, there are no sites where measured CO violations occurred near the proposed transit routes according to available monitoring data. However, modeling of base year worst case conditions indicated violations of the eight-hour CO standard at the Atlantic Avenue/Congress Street intersection. No violations were predicted to occur under any future year build alternative under the worst case conditions modeled. Overall, the proposed transit improvements would have a slight beneficial effect on eliminating or reducing the number and severity of CO NAAQS violations; and

- The microscale analysis indicated that no project alternatives would cause or contribute to violations of the one-hour or eight-hour CO standards at any location.

Under requirements of the Clean Air Act Amendments of 1990, for a transportation project to be determined to conform to an approved SIP, it must derive from an approved transportation plan and program prepared by the applicable metropolitan planning organization (MPO). Further, in CO nonattainment areas, the project must mitigate or eliminate violations of the CO standard that occur in areas where the project will have a substantial effect on traffic volumes, travel patterns, and vehicular emissions. As indicated by the Massachusetts Department of Environmental Protection (DEP) in correspondence dated October 18, 1993, the South Boston Piers Transit Project is an element of the Draft Transportation Plan and the Transportation Improvement Plan (TIP) for the Boston region. The project also would result in net reductions of CO, NMHC, and NO_x emissions and VMT, and would not result in violations of any CO standards. The DEP has indicated that the project conditionally conforms to the Massachusetts SIP.

5.6 NOISE AND VIBRATION ANALYSIS

Potential noise and vibration impacts on structures and people in proximity to the proposed transit alternative alignments would be of both a short-term construction related and a long-term operation related nature. Although noise and vibration are inherently linked — all noise is created by some form of vibration — their impacts are assessed separately.

5.6.1 Noise Impact Assessment

The severity of a noise impact caused by the operation of a transit alternative is assessed in terms of (1) the proximity of noise sensitive receptors to the transit alignment, (2) the relative increase in noise over existing ambient levels, and (3) comparison to a noise level threshold prescribed by the FTA.

The FTA has proposed criteria for evaluating the community noise impacts of transit projects (FTA, 1990) which are based on the noise impact assessment criteria of several federal agencies as well as on scientific studies of the health and annoyance effects of various noise levels. The proposed criteria are presented graphically in Figure 5-9. As shown, the noise impact criteria are defined by two curves that are functions of future project-generated noise levels and the existing ambient noise level at any affected location. The curves define the threshold levels separating three impact categories: (1) no impact; (2) some degree of impact; and (3) severe impact. The curves are based on data defining the relationship between existing (pre-project) noise level and future cumulative level (consisting of the combination of ambient noise and noise specifically attributable to the project). Further details regarding the development of these criteria may be found in the FTA's Draft Guidance Manual.

The noise impact criteria are defined in terms of either L_{dn} or L_{eq}. The L_{dn} descriptor was recommended for use at sites with greater potential nighttime sensitivity to noise level changes, including residences, hospitals, and nursing homes. The L_{eq} metric (specifically for peak transit hour conditions) was recommended for use at locations with predominantly daytime activities such as libraries, schools, parks, and churches. For the proposed transit project, existing ambient noise level measurements were available only as peak hour L_{eq} values at each of the noise evaluation sites. Consequently, the L_{eq} descriptor was utilized as the noise level parameter at all analysis sites to allow use of the available data on ambient noise conditions.

The FTA's noise criteria curve in Figure 5-9 flattens out at levels of 65 DBA (for the curve separating the impact/no impact categories) and 75 DBA (for the curve separating severe impact/impact categories.) The 65 DBA level represents a commonly accepted limit on the amount of ambient noise that can exist and still permit an acceptable living environment. The 75 DBA level represents a similarly accepted limit on the amount of ambient noise that can exist before unacceptable living conditions are created (FTA, 1990).

The FTA has no construction noise regulations regarding the construction of rapid transit systems, relying instead on the regulations of other agencies to limit construction noise. The Federal Highway Administration recommends establishing criteria on a project specific basis, taking into account the difference between existing ambient and projected construction noise. For this analysis, construction noise levels were computed based on information published by the EPA in its review of construction noise (EPA, 1971).

The short-term impacts of construction noise will depend upon equipment type and placement, operating conditions, and construction schedules of the alternative. Pending determination of these specific construction details, noise levels would then be calculated for each alternative and evaluated against local ordinances and guidelines. Mitigation measures that could be implemented to reduce these levels include the following:

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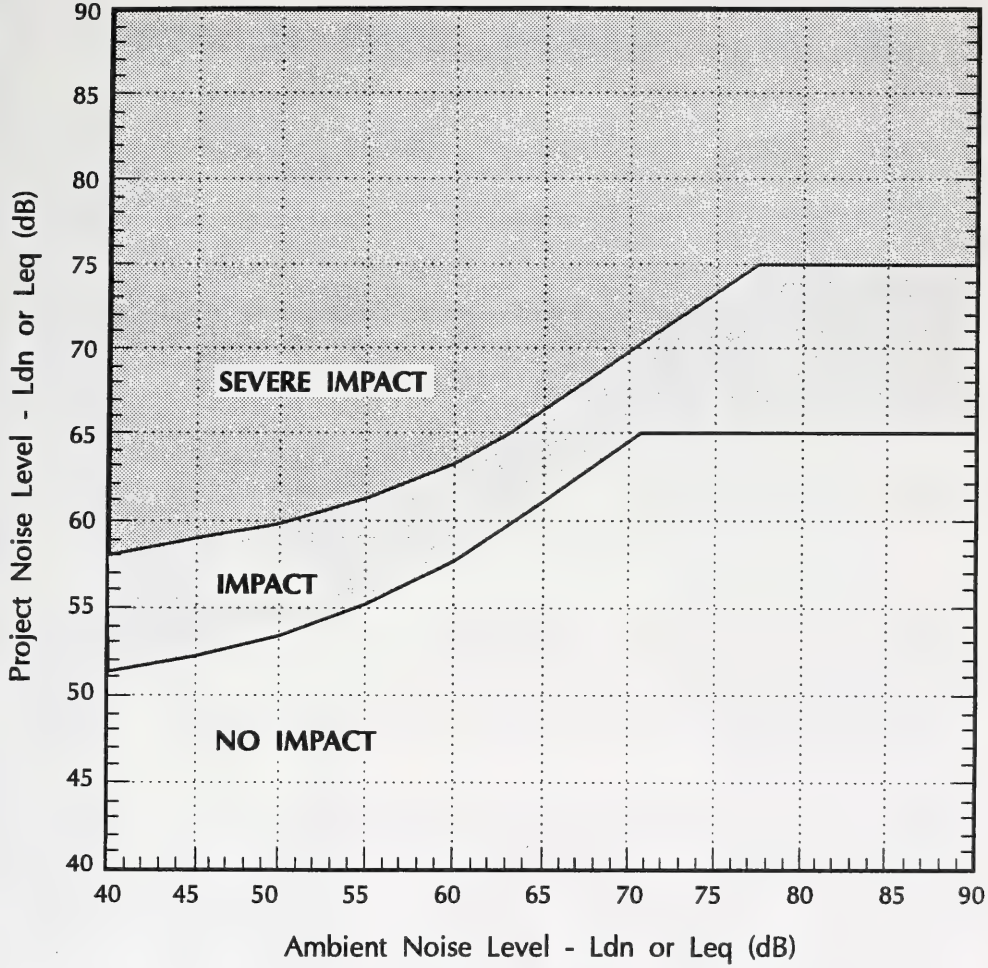
South Boston Piers/ Fort Point Channel Transit Project

Fig. 5-9
Proposed FTA Noise Impact Criteria for Transit Projects[1]



[1] Source: Federal Transit Administration, 1990

- Limiting construction to normal daytime hours (7:00 a.m. to 6:00 p.m.)
- Ensuring that all diesel powered equipment is properly muffled (faulty or ineffective mufflers are major sources of construction noise)
- Erecting temporary noise barriers between sensitive receptors and close or noisy construction operations
- Providing specific routes for truck movement to and from construction sites to avoid streets with sensitive receptors
- Limiting removal of muck from the tunneling operation to specific hours
- Adhering to City of Boston Air Pollution Control Commission (APCC) construction noise ordinances

Ambient noise levels were measured at major intersections near sensitive receptor sites during October 11-13, 1988. Twelve sensitive receptor sites (shown previously in Figure 3-17) have been identified along the alignments of the proposed alternatives. Each measurement site was visited for about one hour. Over this one-hour period, noise was measured for 15 minutes. During the remainder of the hour, traffic counts were made on nearby streets, jet flyovers were noted, and the general character of noise at the site was observed. The noise environment at each site was fairly constant over the one-hour observation period. Consequently, the 15-minute measurement period was typical of the full hour and is considered a representative sample of the ambient noise level. The measurement results are reported as hourly noise levels, $L_{eq}^{(h)}$.

Noise levels were recorded with a Quest Electronics M-28 Noise Logging Dosimeter. The Quest M-28 records a noise measure (DBA) every second and automatically integrates an L_{eq} for the duration of each run. Measured ambient noise levels at sensitive receptor sites were shown previously in Table 3-14.

5.6.1.1 Estimation of Operational Noise Levels

The methodology used to assess the noise impacts of project alternatives was based on the FTA's draft noise impact assessment procedures and noise impact criteria (FTA, 1990). For this project, a General Noise Assessment procedure was used with some modifications. Basically, this procedure represents an approach intended to generate results with a sufficient level of accuracy to allow meaningful comparison of the effects of various project alternatives. However, because of the level of engineering and planning details available at this stage of the project, the General Noise Assessment procedure is not intended to require an intensive analytical effort to derive a high level of accuracy in the results.

Under the General Noise Assessment procedure, noise levels generated by the effects of the various alternatives on traffic volumes and characteristics are computed by applying adjustments to reference sound exposure levels (SELs). The SELs are adjusted to account for variations in traffic volumes, speeds, noise emission levels as a function of vehicle type, and noise source-receiver distance. Worst case assumptions were employed whenever project specific data for any of these parameters were not available. Separate calculations were used to account for the noise effects of three vehicle classes: (1) automobiles and vans; (2) medium trucks and small city buses; and (3) heavy trucks, larger city buses, and commuter or interstate-type buses. As was the case for the air quality analysis, the high growth scenario was used and thus can be considered a "worst case" analysis. The results of this analysis are shown in Tables 5-12 and 5-13 and are summarized below. The locations analyzed were shown previously in Figure 3-14.

TABLE 5-12: COMPARISON OF OPENING YEAR (HIGH GROWTH) PEAK HOUR NOISE LEVELS WITH EXISTING AMBIENT LEVELS AND IMPACT ASSESSMENT

			ALTERNATIVE							
			No Action		Bus/TSM		MOS		Full Build	
Site Number	Sensitive Receptor	Existing Ambient	L_{eq}	Impact Category	L_{eq}	Impact Category	L_{eq}	Impact Category	L_{eq}	Impact Category
1	St. Anthony's Shrine, Monastery, and Chapel	62	51	None	51	None	51	None	51	None
2	Hong Lok Subsidized Housing	65	67	Severe	66	Impact	66	Impact	66	Impact
3	St. James R.C. Church	64	64	Impact	67	Severe	66	***Severe***	64	Impact
4	Tufts New England Medical Center	67	61	None	61	None	61	None	61	None
5	Chauncy House	64	66	***Severe***	65	Impact	66	***Severe***	65	Impact
6	Wang Center for Performing Arts	70	67	Impact	67	Impact	67	Impact	66	Impact
7	Tai Tung Village	49	62	Severe	60	Severe	60	Severe	62	Severe
8	Oak Street Annex	57	58	Impact	55	None	54	None	58	Impact
9	Children's Museum	59	67	Severe	67	Severe	66	Severe	63	Impact
10	Sleeper Street Residential Buildings	62	65	Severe	70	Severe	68	Severe	64	***Impact***
11	Our Lady of Good Voyage Chapel	62	60	Impact	59	Impact	59	Impact	59	Impact
12	Statler Park	66	66	Impact	66	Impact	66	Impact	66	Impact

TABLE 5-13: COMPARISON OF 2010 (HIGH GROWTH) PEAK HOUR NOISE LEVELS WITH EXISTING AMBIENT LEVELS AND IMPACT ASSESSMENT

			ALTERNATIVE							
			No Action		Bus/TSM		MOS		Full Build	
Site Number	Sensitive Receptor	Existing Ambient	L_{eq}	Impact Category	L_{eq}	Impact Category	L_{eq}	Impact Category	L_{eq}	Impact Category
1	St. Anthony's Shrine, Monastery, and Chapel	62	51	None	51	None	51	None	51	None
2	Hong Lok Subsidized Housing	65	66	Impact	66	Impact	66	Impact	66	Impact
3	St. James R.C. Church	64	66	***Severe***	67	Severe	66	***Severe***	65	Impact
4	Tufts New England Medical Center	67	63	Impact	62	***None***	62	***None***	62	***None***
5	Chauncy House	64	64	Impact	65	Impact	65	Impact	65	Impact
6	Wang Center for Performing Arts	70	68	Impact	67	Impact	67	Impact	65	Impact
7	Tai Tung Village	49	63	Severe	63	Severe	62	Severe	63	Severe
8	Oak Street Annex	57	58	Impact	59	Impact	58	Impact	60	Impact
9	Children's Museum	59	66	Severe	67	Severe	68	Severe	64	Severe
10	Sleeper Street Residential Buildings	62	68	Severe	70	Severe	68	Severe	70	Severe
11	Our Lady of Good Voyage Chapel	62	64	Impact	63	Impact	63	Impact	62	Impact
12	Statler Park	66	67	Impact	67	Impact	67	Impact	67	Impact

No Action Alternative

In terms of the noise impact criteria, the No Action Alternative would result in no impact at two receiver sites, some level of impact at two receiver sites, some level of impact at ***five*** sites, and severe impact at ***five*** sites in the opening year. In the year 2010 high growth scenario, this alternative would have no impact at only one site, while ***seven*** sites would experience some level of impact and ***four*** sites would experience severe impacts per the FTA criteria.

Bus/TSM Alternative

In the opening year, the Bus/TSM Alternative would result in no impacts at three receiver sites, some level of impact at five sites, and severe impacts at four sites. In the year 2010, four sites would again be severely impacted, while six sites would experience some level of impact and two sites would not be impacted. The number of severely impacted sites (of the set of twelve used in this analysis) would be comparable to that under the No Action Alternative in both years of analysis, while there would be an increase of one site in the no impact category in both the opening year and 2010.

Fort Point Channel Underground Transitway/MOS Alternatives

The two MOS Alternatives would generate equivalent noise impacts at each of the receiver sites under analysis. Both would result in five severely impacted sites in the opening year and ***four*** in the design year under the high growth scenario, the highest number of severely affected sites of any of the project build alternatives. Mitigation measures may include soundproofing of structural elements including multiple glazing of windows for residential structures. Details would be developed in coordination with the owners and occupants of these facilities following additional acoustic and structural analysis of these structures. The capital costs of such mitigating actions are within the contingencies now included in the capital cost estimate for each alternative. The number of sites experiencing some level of impact would be four in the opening year and ***six*** in 2010, one less than the number in the equivalent category under the Bus/TSM Alternative ***and the same number in 2010***. The number of sites that would not be impacted is the same for the MOS Alternatives and the Bus/TSM Alternatives in both the opening year (three sites) and 2010 (two sites).

Fort Point Channel Underground Transitway/Full Build Alternative

In the opening year of 2000, the Full Build Alternative would generate severe noise impacts at only one site, the lowest number of sites falling under this impact category of all the project alternatives. In 2010, the predicted number of severely impacted sites would increase to three, less than any of the other alternatives. The Full Build Alternative would have the highest number of sites that would experience some level of impact in the opening year of any project alternative (nine in total). In 2010, the number of such sites would be ***seven***, equivalent to the number predicted for the No Action Alternative but greater than the number expected under either the Bus/TSM or MOS Alternatives. The Full Build Alternative would have no noise impacts at two receiver sites in the opening and design years.

5.6.1.2 Estimation of Construction Noise

Noise impacts during construction would be temporary, but may add to the high existing traffic noise levels at some locations. Appropriate criteria have not been developed to establish the relationship between construction noise level and human response.

For this analysis, construction noise levels were computed based on information published by EPA in its review of construction noise (EPA, 1971). Using the EPA data, an L_{eq} was calculated for each phase of project construction. Results of this calculation are shown in Table 5-14. These construction noise computations are based on nationwide average construction scenarios. Actual construction noise for any of the transit alternatives would depend on equipment placement, operating conditions, and construction schedules, as well as usage and equipment types. Detailed noise level analysis, by construction segment and activity, will be prepared by Transitway section designers as more detailed plans are developed.

TABLE 5-14: NOISE LEVELS DURING CONSTRUCTION

Phase	Noise Level (DBA: L_{eq})
Clearing	88
Excavation	90
Foundation	93
Erection	90
Finishing	90
Overall Average: 90 dBA L_{eq}	

Note: The above noise levels are estimated at 50 feet from the construction site.

5.6.2 Vibration Analysis

Criteria for assessing the impact of ground vibration have been established by the National Academy of Sciences, Committee on Hearing, Bioacoustics, and Biomechanics (CHABA). According to these criteria, the severity of vibration impact is based upon its potential to cause (1) major structural change, (2) minor architectural damage, and (3) annoyance. These three assessment categories are described more fully in Chapter 3, Section 3.5.2, and are summarized below:

- **Structural Damage**: If exposed to sufficiently high levels of ground vibration, a building may suffer structural damage, such as glass breakage or cracking plaster. A peak vibration velocity (i.e., the overall velocity of an object during vibratory motion) of 2.0 inches/second (in/sec) has been determined by CHABA as the threshold below which structural damage due to vibration is unlikely.

- **Architectural Damage**: Naturally occurring damage to building architecture resulting from climate, settlement, and deterioration of materials may be exacerbated by construction and traffic-related vibration. The threshold for architectural damage to buildings occurs at a peak velocity of 0.2 in/sec. In the case of historic buildings, however, a peak velocity of 0.08 in/sec serves as a more conservative threshold for architectural damage to these sensitive structures.

- **Annoyance**: Perceptible vibrations caused by transit operation and construction equipment may cause annoyance to people in the vicinity. The degree to which people are annoyed is a function of both the intensity of the vibrations and the use of the affected building.

5.6.2.1 Estimation of Construction Vibration Levels

Vibration levels during construction depend on the type of activity occurring and the machinery being used, which is likely to vary throughout the construction period. Because construction is considered temporary, the greatest concern is to ensure that damage levels of vibration do not occur at buildings in the vicinity. Therefore, the maximum vibration level for any given construction operation is used to determine the estimate of impact. Much of the vibration of concern in construction is called "impulsive," which is caused by ground impacts from construction equipment such as pile drivers and shovel buckets used in slurry wall construction. For this type of vibration, the peak velocity is the preferred unit of measurement.

For construction of the project alternatives, the major source of vibration would be pile driving. Other movement of construction equipment, including graders, loaders, dozers, scrapers, and trucks, would be generally of the same order of magnitude as the groundborne vibration, which is created by heavy vehicles operating on local streets. Groundborne vibrations from such vehicles, even on rough terrain, are not often sufficient to be noticeable in adjacent community areas; the vibration is usually imperceptible or barely perceptible (American Public Transit Association, 1981). Therefore, the impact generated by normal vehicle activities at construction sites can generally be assumed to be insignificant. Construction period vibration would be estimated for the worst possible case — pile driving. Slurry wall construction, another major source of construction vibration, would be estimated for alternatives where pile driving is not used.

5.6.2.2 Estimation of Operational Vibration Levels

The purpose of this assessment is to identify vibration-sensitive buildings in potential transportation corridors that may have excessive vibration and groundborne noise levels as a result of implementation of a particular transit alternative. Operational vibration effects due to implementation of the transit alternatives could result from vibration generated by motor vehicle traffic and transit buses.

Traffic vehicles cause ground vibration through fluctuating forces at the interface between vehicle wheels and roadway. The magnitude depends on the weight and speed of the vehicle and the roughness of the road surface. Ground vibration is caused by any discontinuity of the road surface. A pothole in the road may be sufficient to make the passage of an automobile perceptible.

The assessment of construction and operational impacts due to implementation of the project alternatives can be made by comparing predicted vibration levels with vibration criteria. A comparison will result in a set of distances between vibration source and receptor within which vibration impacts could occur for various types of buildings and structures. These distances are summarized in Table 5-15.

5.6.2.3 Potential Vibration Impacts By Alternative

Potential vibration impacts resulting from the construction and operation of each transit alternative are discussed below. Given the similarity of their impacts, the three Transitway Alternatives are discussed together.

No Action Alternative

In the No Action Alternative, the MBTA would marginally increase bus service in the Piers area by adding approximately thirty buses to the assigned service fleet.

Ground vibration has been observed to peak with the passage of an individual vehicle. It has been found that increased traffic volumes will not increase ground vibration peak values, but will increase the number of peaks that occur in a unit of time.

The No Action Alternative would not involve the introduction of new vibration sources to the project area. Minor increases in bus frequency would not increase vibration peaks. The vibration environment for this alternative would be similar to the existing environment. Therefore, no vibration impacts are anticipated under this alternative.

TABLE 5-15: ESTIMATED DISTANCE BETWEEN SOURCE AND RECEPTOR WITHIN WHICH A VIBRATION IMPACT MAY OCCUR

Damage Effects		Architectural Damage	
Vibration Source	**Structural Damage (ft)**	**Historic Building (ft)**	**Non-Historic Building (ft)**
Construction			
Pile Driving	6	150	60
Slurry Wall Construction	1	10	5
Operational			
Rough Roads	NA	6	3
Smooth At-Grade Roads	NA	2	1

Annoyance Effects	Building Category			
Vibration Source	**Hospital (ft)**	**Hotel/ Residential (ft)**	**Office (ft)**	**Factory (ft)**
Construction				
Pile Driving	400	320	250	150
Slurry Wall Construction	160	110	50	30
Operational				
Rough Roads	50	40	15	5
Smooth At-Grade Roads	15	10	5	2

NA Data not available.

Bus/TSM Alternative

New routes for the Bus/TSM Alternative would traverse streets that currently have no bus traffic. Additionally, some streets with existing bus routes would experience major increases in bus traffic. However, vibration effects on these streets would be far below the criteria for structural and architectural damage. The possibility exists for people in buildings along South Street from Park Square to Oak Street, and on Oak Street between Tremont and Washington Streets, to be subjected to vibration annoyance effects. This would only occur if roadways are allowed to substantially deteriorate. Such effects could easily be mitigated by maintenance of a smooth roadway. No significant long-term traffic vibration effects are anticipated as a result of implementing this alternative.

The additional buses also require an at-grade storage and maintenance facility located in the South Boston industrial area at the Massport Maritime site between Fargo and West First Streets. Construction of the facility would use typical heavy construction equipment, such as dozers, backhoes, pavers, and trucks. Ground vibration from these types of construction equipment would not exceed criteria for structural (2.0 in/sec peak velocity) or architectural (0.2 in/sec peak velocity) damage. Therefore, no significant construction-related vibration effects are anticipated due to the implementation of the Bus/TSM Alternative.

Fort Point Channel Underground Transitway Alternatives

The Underground Transitway Alternatives would utilize trackless trolleys (electric buses). As a result, groundborne vibration generated by underground electric bus operations would be minimal as long as tunnel floors are maintained in smooth condition. Minor low frequency vibration due to bus operations would not be of sufficient magnitude to exceed annoyance criteria or structural damage criteria.

Ground vibration from construction activity is not expected to exceed the criterion limit for structural damage (2.0 in/sec peak velocity) at any building or structure along the proposed alignment. Widespread pile driving is not anticipated during construction, but slurry wall construction is likely. Mitigation action may be required to avoid potential architectural damage at historic buildings adjacent to the slurry wall construction, particularly along Tremont and Avery Streets for the Full Build Alternative.

In terms of vibration annoyance, it is estimated that criteria for buildings may be exceeded at four buildings during pile driving activity that could occur near the Fort Point Channel if the tunnel crossing of the channel is constructed using the cofferdam method. These buildings include Harbor Plaza and Hook Lobster on the downtown side of the channel and the Computer Museum end of the Children's Museum complex and a building owned by Stone and Webster on Northern Avenue on the South Boston side of the channel. This construction activity would take place on both sides of the channel just south of what would be New Northern Avenue. It is expected that people working within about 200 feet of the construction site would be annoyed by vibration during pile driving. Pile driving operations would be expected to occur for a maximum of two months, producing building vibration peak velocities of 0.04 in/sec or less; such vibration levels may be characterized as "easily noticeable." Potential methods of vibration mitigation at these sites would include pre-auguring and the use of low-displacement bearing piles.

Construction of the Underground Transitway along Atlantic Avenue to Congress Street, where the alignment turns east into South Boston, would be built in conjunction with the northbound Central Artery and would not add significantly to the vibration levels resulting from that project.

The MOS-1, MOS-2, and Full Build Alternatives would all require construction of a storage and maintenance facility at one of two sites on a Massport-owned parcel in industrial South Boston with the same construction impacts as identified above in the Bus/TSM Alternative (see Section 5.6.2.2).

5.7 ECOSYSTEMS

The major potential impacts on ecosystems would originate from construction related activities within the Fort Point Channel associated with the Transitway Alternatives. On land, the most significant impact would be associated with rodent control. There would be no permanent impacts caused by the operation of any of the alternatives. There would no permanent or temporary impacts to upland vegetative or wildlife communities.

Given the importance of Chapter 91 regulations in this impact category, a discussion of Chapter 91 is provided first in this section.

5.7.1 Chapter 91 Waterways License

The placement and use of fill or structures within the limits of flowed (existing) or filled (historic) tidelines is subject to Chapter 91 Waterways Licensing, per 310 CMR 9.00, and as administered by the Massachusetts Department of Environmental Protection (DEP) Division of Wetlands and Waterways. Much of the project area, and virtually all of the project area within South Boston, lies within former tidelands. However, with the exception of the Fort Point Channel crossing associated with the Transitway Alternatives and the proposed maintenance facility at either West First Street or Summer Street and Pappas Way associated with all but the No Build Alternative, these are landlocked tidelands, not subject to Chapter 91 Licensing (310 CMR 9.04[2]). Landlocked tidelands are defined as those filled tidelands entirely separated from flowed tidelands by a public way, or 250 feet, whichever is the greater distance.

Per the Chapter 91 regulations the maintenance facility and transit projects are defined as an "Infrastructure Facility: ...a facility which produces, delivers, or otherwise provides ... transportation ...services to the public" (310 CMR 9.02). The section of the Transitway that crosses the Fort Point Channel is further defined as an "Infrastructure Crossing Facility: ...an infrastructure facility which is a ...tunnel ...which is located on or under the water and which connects existing or new infrastructure facilities located on opposite banks of the waterway." Although DEP could find the Fort Point Channel crossing to be a water-dependent infrastructure facility which could not be reasonably located at an inland site and still serve the area proposed (310 CMR 9.12[2][b] & [d]), such standards cannot be met by the maintenance facility. The project is thus defined as nonwater-dependent and will be reviewed under 310 CMR 9.55 "Standards for Nonwater-Dependent Infrastructure Facilities."

The Standards for Nonwater-Dependent Infrastructure Facilities establish guidelines for ensuring project avoidance or impact mitigation relative to the water-related interests of the public. These interests include:

- ***the protection of maritime commerce, industry, recreation and associated public access;***
- ***the protection, restoration, and enhancement of living marine resources;***
- ***the attainment of water quality goals;***
- ***the reduction of flood and erosion-related hazards on lands subject to the 100-year storm event or to sea level rise, especially those in damage-prone or natural buffer areas;***
- ***the protection and enhancement of public views and visual quality in the natural and built environment of the shoreline;***

- *the preservation of historic sites and districts, archeological sites, and other significant cultural resources near waterways.*

In addition to the above, such projects must "take reasonable measures to provide open spaces for active or passive recreation at or near the water's edge...".

The above standards will be applied during the permitting process for the selected transit alternative and maintenance facility location. Certain aspects and/or impacts are, however, common to all build alternatives. These are reviewed below relative to the standards of 310 CMR 9.55.

Protection of maritime commerce, industry, recreation and associated public access

The proposed transit project establishes an important public transportation link between "downtown" Boston and the South Boston Piers area. As such it is supportive of the continued maritime use of the area, creating a wider, more all-encompassing accessway to the Commonwealth's Boston Harbor waterfront. Although none is located in regulated Chapter 91 areas, the two passenger facilities of the Bus/TSM Alternative, the portal station of the MOS-1 Transitway Alternative and the Courthouse and World Trade Center Stations of the MOS-2 and Full Build Transitway Alternatives are all located at the edge of regulated waterfront and create linkage to existing, regulated waterfront accessways and uses. Under the Transitway Alternatives, egress for the Courthouse and World Trade Center Stations will occur on both sides of New Northern Avenue, facilitating access to the waterfront by eliminating the need for at-grade pedestrian crossing of the street. Along the Fort Point Channel, Harborwalk segments will be reestablished/constructed following construction of this section of the tunnel, adding to the ultimate establishment of a continuous Harborwalk system on either side of the channel.

Recreational and commercial navigational use of the Fort Point Channel will not be impeded by project construction as an adequate obstruction-free channel width will be maintained at all times. However, all of the Transitway Alternatives have potential construction-related impacts to maritime industries along the Fort Point Channel. As discussed in Chapter 3 and Section 5.8.3.1, these impacts are associated with industrial and/or commercial users of channel waters: James Hook and Company, Neptune Lobster Company, the Gillette Company and the New England Aquarium. Implementation of the Transitway Alternatives will have no impact on the physical structures associated with these industries. However, as discussed in the above-reference sections, dredging associated with the construction of the Transitway tunnel beneath the Fort Point Channel has the potential to negatively impact water quality in the channel and thereby impact the ability of these industries to utilize this water. Proposed construction mitigation measures to prevent disruption of channel water use include alternative construction methodologies, the use of siltation curtains around both the construction area and the user intakes, the use of closing clamshell dredge buckets, reduction of dredging times and the development of alternative seawater sources.

Finally, implementation of the MOS-2 or Full Build Transitway Alternatives may require the taking of the Seafood Cooperative, a water-dependent industrial facility (310 CMR 9.12[2][b]4). Selection of the maintenance facility alternative at Summer Street and Pappas Way would require the taking of the Subaru overflow lot, also a water-dependent industrial use (310 CMR 9.12[2][b]1). An inventory of the tenants of the Seafood Cooperative, their current equipment inventory and their anticipated future space and equipment needs is presented above in Section 5.2.4. The need for this taking and the selection of a comparable relocation site will be determined during the design stages of the selected alternative and resolved within the permitting process. Similarly, pending selection of the Summer Street/Pappas Way site for the maintenance facility, alternative parking overflow capacity will be developed during the permitting process for the selected alternative.

Protection, restoration, and enhancement of living marine resources

Wetland resource areas within the project area are limited to those associated with the Fort Point Channel; specifically, Land Under the Ocean, Coastal Banks (including a 100-foot buffer zone), Fish

Runs and Lands Subject to Coastal Storm Flowage. In that the Transitway will pass beneath the Fort Point Channel, no long-term impacts to any of these resource areas are anticipated for the project. Construction of the channel portion of the Transitway does, however, have the potential for short-term, construction related impacts. These are, for the most part, associated with water quality impacts resulting from the dredge crossing of the channel.

As noted in Chapter 3, moratoriums on dredging in Boston Harbor exist between February 1 and June 15 to protect anadromous fish during migration and spawning. Unless the cofferdam, or possibly the closed clamshell dredge, methodology is used for crossing the Fort Point Channel for the Transitway alternatives, it is highly likely that these moratoriums will be enforced during these periods.

Attainment of water quality goals

Water quality impacts are associated with construction-related stormwater runoff in all build alternatives, dredging-related turbidity associated with Transitway crossings of the Fort Point Channel and long-term stormwater runoff from the maintenance facility of the Bus/TSM and Transitway alternatives. Methods to minimize and mitigate dredging impacts to water quality are reviewed in Section 5.8.3.1. Methods to minimize and mitigate stormwater runoff impacts are reviewed in Section 5.8.3.2. Water quality impacts and their attenuation will also be reviewed and regulated under the U.S. EPA's National Pollution Discharge Elimination System (NPDES) permitting process.

Reduction of flood and erosion-related hazards

None of the alternatives requires construction in a flood prone area. The seawall to either side of the Fort Point Channel will likely be temporarily dismantled during construction of the Transitway Alternatives, but will be replaced to its full extent.

Protection and enhancement of public views and visual quality in the natural and built environment

With the exception of the maintenance facility associated with the action alternatives, none of the alternatives involves significant above-grade construction. The two sites under consideration for the maintenance facility are located more than 100 and 300 feet from the waterfront, and are located in built areas. As currently envisioned, the maintenance facility is to be less than 35 feet in height and would meet the quantitative dimensional requirements of a nonwater-dependent use other than an infrastructure facility.

Implementation of the Transitway Alternatives will require the reestablishment/construction of the Harborwalk on either side of the Fort Point Channel. This will enhance the visual accessibility of the water at these locations. The taking of the Victoria Station restaurant on the east side of the channel will create opportunities for expanded open space development in this area, adjacent to the waterfront park proposed by the Children's Museum/the Computer Museum. Similarly, opportunities exist for expanded waterfront access along Pappas Way near both of the proposed maintenance facility site options. These and other options will be explored more fully during the permitting process.

Preservation of historic sites and districts, archaeological sites, and other significant cultural resources near waterways

Existing historic and archaeologic sites in the project area are reviewed in Chapter 3. Impacts and their mitigation are reviewed in Sections 5.10 and 5.11.

5.7.1 No Action Alternative

Given the absence of any construction activity associated with the No Action Alternative, no impacts to ecosystems would occur. The proposed slight expansion of the service area under the alternative would not meet the Chapter 91 goal of improving access to the waterfront to the extent that the other alternatives would.

5.7.2 Bus/TSM Alternative

With the exception of surface passenger facilities and the storage/maintenance facility, the Bus/TSM Alternative would not require any new construction in or adjacent to water resources or filled tidelands. Although the two surface passenger facilities proposed in the Piers area are located over formerly filled tidelands, neither is located within the Chapter 91 jurisdictional boundaries as described in Chapter 3, Section 3.6.2, and shown in Figure 3-15. However, the two site options for the storage/maintenance facility would be located on filled tidelands that lie within Chapter 91 boundaries. Since these sites are both more than 100 feet from the banks of the Reserved Channel, and are not within the 100-year floodplain, only a Chapter 91 License would be required, with the attendant Massachusetts Coastal Zone Management (MCZM) consistency review. Given that the proposed location for the facility is not adjacent to a water resource, no wetland resource impact considerations are applicable.

Consistent with the Chapter 91 goal of improving access to the waterfront, provision of expanded bus service in the project area would facilitate water-dependent use and revitalization of the waterfront. If located at Site A on the corner of Summer Street and Pappas Way, however, the storage/maintenance facility would displace water-dependent accessory uses. The MBTA would assist Massport with the relocation of any existing water dependent tenants displaced by construction of the facility. ***Opportunities for expanded public waterfront access along Pappas Way will be explored in the permitting process for a maintenance facility at either of these locations.***

While construction activities associated with the Bus/TSM Alternative would not cause the significant displacement of existing rodent populations, the construction of the storage/maintenance facility could result in localized rodent disturbance. The degree of such disturbance would be related to the amount of habitat disruption either through demolition of existing structures or the excavation of new foundations. A rodent control program such as described in Chapter 3, Section 3.6.5, would be appropriate for the anticipated level of construction activity. ***The general approach outlined in the MBTA specifications consists of poisoning areas with the use of a toxicant (i.e., zinc phosphide) combined with a suitable bait. Such operations are conducted by extermination contractors licensed by the Commonwealth of Massachusetts. Similarly, any pesticides utilized must be registered with the Massachusetts Bureau of Pesticides. The treated bait is placed in structures that will be razed and in adjacent areas in order to attract the largest possible number of rodents. This phase is commonly referred to as the "Blitz." Anticoagulant is applied in accordance with the manufacturer's standard recommended practice and as outlined in the MBTA specifications. Records of placement, type, and volume of applied rodent baits are maintained. Carcasses are removed daily. Following initial applications, baiting is continued to prevent rodent migration.***

5.7.3 Fort Point Channel Underground Transitway/MOS-1 Alternative

The MOS-1 Alternative would require short-term impacts to the banks and waterways of the Fort Point Channel, as well as construction activities within filled tidelands. As such, this alternative would require federal and state waterways related permits and licenses.

A federal Section 10/404 Permit would be required for construction activities within the Fort Point Channel. The short-term, temporary impacts to water quality, hydrodynamics, and marine life are the key issues for waterways-related ecosystem impacts subject to U.S. Army Corps of Engineers (ACOE) review. If the cofferdam construction method is used, short-term impacts to ecosystems could include resuspension of bottom sediments, constriction of the channel width by one-half, removal of marine benthos in the dredged areas, and temporary disturbance of fisheries habitat. While the immersed tube construction method would

have similar impacts, temporary changes in water quality caused by resuspension of sediments would likely be greater, but no channel constriction would be required. Regardless of the construction method used, none of these impacts would extend beyond the construction period.

Work within and adjacent to the Fort Point Channel and filled tidelands would require state permits, licenses, and/or approvals pursuant to the Massachusetts Wetlands Protection Act, Chapter 91, MCZM, and Water Quality Certification. Impacts that would be addressed by these permits and approvals can be classified as either environmentally related or related to public benefits. Potential short-term environmental factors that would be addressed by these permits and approvals include temporary disturbances to the floodplain, channel banks, and wildlife use of the channel during tunnel construction. These impacts are expected to be minor, and none would extend beyond the construction period. Compliance with Chapter 91 and MCZM as they relate to use and protection of the waterfront and coastal zone is reflected by the improved public access provided by the MOS-1 Alternative. ***Additionally, the Harborwalk along the Fort Point Channel will be reestablished/constructed and opportunities for expanded waterfront open space explored at the Victoria Station restaurant site. Similar opportunities for expanded waterfront access will be explored along Pappas Way near the proposed maintenance facility.*** Displacement of water dependent accessory uses by construction of a storage/maintenance facility on one of the two Massport Maritime sites would be mitigated by relocation assistance.

A rodent control program above as above for the Bus/TSM Alternative would be implemented to mitigate potential displacement of rodent populations.

5.7.4 Fort Point Channel Underground Transitway/MOS-2 Alternative

Since the MOS-2 Alternative would require the same crossing of the Fort Point Channel as the MOS-1 Alternative, the impacts to ecosystems would be essentially the same (see Section 5.6.3). The sole difference would be related to Chapter 91 public benefit considerations. The MOS-2 Alternative would provide grade-separated transit service from South Station to the World Trade Center, while the MOS-1 Alternative would provide this service only between South Station and Courthouse/Fan Pier. The MOS-2 Alternative would therefore provide superior public transportation linkage to the World Trade Center, whose Chapter 91 benefits include enhanced pedestrian and visual access to the waterfront, docking space along Commonwealth Pier, and connection to a potential future water shuttle. ***Other Chapter 91 benefits described for the MOS-1 Alternative would occur in MOS-2. The location of the egress for the Courthouse and World Trade Center Stations on both sides of New Northern Avenue would also facilitate access to the waterfront.***

Rodent displacement caused by construction of the MOS-2 Alternative would be mitigated through implementation of a baiting and monitoring program as described above.

5.7.5 Fort Point Channel Underground Transitway/Full Build Alternative

The Full Build Alternative would require the same crossing of the Fort Point Channel as the two MOS Alternatives. The impacts to ecosystems would therefore be the same as described in Section 5.7.3. However, in terms of Chapter 91 public benefits, the Full Build Alternative would provide the best access to the waterfront of all alternatives by virtue of its direct connection from Boylston Station to the Piers area.

Construction of the Full Build Alternative would cause rodent displacement. The baiting and monitoring program outlined above for the Bus/TSM Alternative would serve to control rodent infestation.

5.8 WATER RESOURCES

The Fort Point Channel and Boston Harbor are the focus of potential water resource impacts of the transit alternatives. The potential water quality impacts of stormwater runoff and groundwater discharge are of particular concern relative to both waterbodies. Potential impacts to tidal circulation, navigation, and

process water use are also of concern in the Fort Point Channel. The involvement of various regulatory agencies, including the Army Corps of Engineers, is discussed in Chapter 3, Section 3.7.

5.8.1 No Action Alternative

The No Action Alternative would involve no construction/excavation activities in the Fort Point Channel or elsewhere within the project area. Hence, there would be no impact to the water resources of the Fort Point Channel or Boston Harbor. Implementation of this alternative would not result in any significant impacts on current stormwater flows or groundwater discharges in the project area.

5.8.2 Bus/TSM Alternative

The Bus/TSM Alternative does not include any significant excavation or land use alterations. The only construction associated with this alternative involves the bus storage and maintenance facility and three passenger facilities, two in the Piers area and one in downtown Boston. No work would be conducted within the Fort Point Channel, and no increase or change in existing stormwater runoff patterns along the bus alignments/routes would occur. Hence, no significant impacts to project area water resources are anticipated from implementation of the Bus/TSM Alternative.

Construction area runoff would be associated with construction of the storage/ maintenance facility and the three passenger facilities. Since the construction area would be greater than 5 acres, a National Pollution Discharge Elimination System (NPDES) permit would have to be obtained for discharge of runoff during the construction phase. Limitations and conditions of the NPDES permit are described in Chapter 3, Section 3.7.1. Once constructed and operational, the facility would be classified under EPA Stormwater Regulations as a facility engaged in "industrial activity" (40 CFR Part 122.26). As such it would require a post-construction NPDES permit for stormwater discharges.

5.8.3 Fort Point Channel Underground Transitway Alternatives

Potential impacts associated with all three Transitway Alternatives include those associated with construction phases of the Fort Point Channel crossing and groundwater and stormwater maintenance. The former include water quality and navigational issues in the channel, while the latter include water withdrawal and discharge. The degree of impact is essentially the same for each alternative and is therefore addressed collectively.

5.8.3.1 Fort Point Channel Transitway Crossing

Two construction methodologies are being considered for crossing the Fort Point Channel. These include a modified sunken or immersed tube method, and a half-channel cofferdam method.

Modified Sunken Tube Method

Under the modified sunken tube method, dredging of the channel will occur within a semi-confined area. Specifically, two parallel rows of steel sheeting will be driven into the channel bed along the alignment to preclude the necessity of side-slope excavation. The channel bed between the rows of sheeting will then be excavated to the necessary depth. Upon proper preparation of the channel bed, a single tube section, constructed off-site and sealed at each end, will be floated into position over the dredged alignment and lowered (or "sunk") into place. Crossing of the channel will require three such sections and will result in a navigational constraint of approximately one half the width of the channel at any given time. As discussed in Chapter 3, Section 3.7.4, such limitations will not impact navigational use of the channel. Upon completion of construction the channel bottom would be backfilled to original contours with clean, compatible sediments.

Channel crossing activities conducted by the modified sunken tube method will have virtually no impact on tidal velocity, excursion or flushing. However, in that channel dredging will be conducted in open water, temporary increases in suspended solids concentrations will take place. This has

the potential to impact four users of saltwater from the Fort Point Channel: James Hook and Company, Neptune Lobster Company, The Gillette Company, and the New England Aquarium.

Sediment dispersion modeling for dredging in the Fort Point Channel indicates a high level of suspended solids (approximately 1,500 mg/l) at the dredge site, attenuating to background concentrations (estimated at 5 mg/l) approximately 2,300 feet up-channel from the crossing locale (Frederic R. Harris, Inc., 1993). In the down-flow direction, suspended solids will be elevated at the locations of James Hook and Company and Neptune Lobster Company, which are located approximately 450 feet and 375 feet, respectively, from the project area. At these locations, the simulated sediment concentrations are between 40 and 50 mg/l when the dredging is closest to the intakes. As the tide cycle swings from flood to ebb, the concentrations will be higher due to the changes in tidal flow direction and reduced velocity which allows higher concentrations to accumulate in the plume. In the cross-channel direction, suspended solid concentrations will be at background approximately 325 feet from the dredge. Since the channel is approximately 650 feet wide at the location of the Transitway crossing, it is possible that, while dredging is being conducted on one side of the channel, one lobster company will be within the sediment plume while the other may not.

The Gillette Company's main and temporary intakes are beyond the limits of tidal excursion from the Transitway site. The sediment plume dispersion simulations indicate that suspended solids levels will return to background conditions before the temporary intake. Accordingly, it is unlikely that the Gillette Company will become affected by the Transitway construction. However, mitigation is discussed below in the unlikely event of an impact.

Although the New England Aquarium is 2,200 feet from the project site, it could also be slightly affected by suspended solids. On the ebb tide, the suspended solids plume will be carried out of the Fort Point Channel and into the tidal delta area between Fan Pier and the Aquarium (a distance of approximately 2,200 feet). The simulated suspended solids concentration at this distance is 7 mg/l above background. The flood tide could then push the solids towards the Aquarium's intake. Although minor in change, the solids concentrations could result in longer periods of filtration through the Aquarium's seawater system.

Because sediments from the upper 4 to 20 feet of the channel are contaminated with metals, polynuclear aromatic hydrocarbons (PAH) compounds, and total petroleum hydrocarbons (TPH), they are not suitable for ocean disposal. During dredging operations these sediments will likely be placed on deck barges for dewatering prior to disposal at an approved disposal site (see Chapter 5, Section 5.9). Should deck barges be utilized, they will be outfitted with perforated peripheral drains that have been wrapped with filter fabric to facilitate dewatering and filtration prior to loading onto trucks for transport to the disposal site. In addition, the barges containing sediment being dewatered will be surrounded with silt curtains to limit the spread of turbid water. During dredging, the organic, near-surface sediments will be removed first to prevent mixing with the cleaner, underlying materials.

As noted in Chapter 3, Section 3.6.4, moratoriums on dredging in Boston Harbor exist between February 1 and June 15 to protect anadromous fish during migration and spawning. Unless a closed clamshell dredge is used for dredging of the Transitway tunnel, it is highly likely that the moratoriums will be enforced during this period. The moratoriums are not anticipated to be an impediment to the project schedule.

Although dredging could be conducted in an eight week period, the impacts to water quality conditions at the intakes for Hook and Neptune lobster companies are a major consideration because both intakes are located within 4 feet of the channel bottom. The suspended solids at this depth will be high enough to possibly cause closure of both operations unless mitigative measures are taken.

A number of measures can be taken individually or collectively to mitigate the impacts of increased suspended solids. These include:

- *Closing Clamshell Dredge Buckets. The easiest of these mitigation measures is to use a closing clamshell dredge bucket similar to that being used on the Third Harbor Tunnel harbor crossing. The closing bucket eliminates losses of sediment from spillage over the top of the bucket. While this will not entirely eliminate turbidity, as sloughing of sediment off the bucket sides will continue, it will lead to a considerable reduction in the level of suspended solids. When combined with care in the rate of bucket lifting and manner in which the barge is loaded, water quality impacts could be reduced by the use of closing buckets.*

- *Silt Curtains. Silt curtains could also be deployed around the dredge site to contain suspended solids. In normal use, the deployment of a silt curtain is generally limited by tidal velocity and water depth. At the Transitway crossing the silt curtain would need to extend the total depth of the water column to contain the turbidity plume.*

- *Reduced Dredging Time. It is possible to minimize water quality impacts to seawater users in the Fort Point Channel by dredging for only four of the six hours of the ebb tide cycle. The two-hour, non-dredging period would allow for solids to settle in the water column, as well as allow turbid water to flow past the mouth of the channel and into Boston Inner Harbor where it would be diluted before portions of it re-entered the Fort Point Channel. It would be necessary for the lobster companies to stop using seawater during the 4 hours of ebb cycle dredging, as turbid water would still be flowing by their intakes during this period.*

  While lobsters and shellfish can be safely held for short periods without cycled water during cool weather, this practice is not possible during warmer or colder weather. At these times the animals will either suffocate from the lack of oxygen or freeze. In addition, this option would result in significantly increased costs for the dredging due to the longer dredging period. Depending on time of the year and daily weather conditions, this is an option that could be utilized as a primary mitigation measure, or put into place in the event of emergency conditions.

- *Alternative Seawater Sources. Temporary seawater sources could be provided to the lobster companies through the use of floating or remote intakes. Floating intakes are generally less desirable as the near surface water can be less saline during high stormwater runoff events, or of higher temperature, primarily during the warmer months.*

  A temporary water intake could be installed at a harbor location that is removed from the sediment plume. However, this would require installation of considerable lengths of underwater piping.

- *Temporary filtration. Temporary filtration is not a viable alternative because of the extremely large system capacity requirement (approximately 3,500 gallons per minute).*

Cofferdam Method

The cofferdam method differs from the modified immersed tube method in that all construction occurs in place. This method entails driving sheet piling across one half of the Fort Point Channel, while leaving the remaining half of the channel open for tidal flushing and navigation (see Chapter 3, Section 3.7.4). Once the sheet piling is installed, the confines of the cofferdam are dewatered and excavated to the tunnel design depth. The Transitway tube is then cast in place. Upon

completion of the first half, the cofferdam is completely removed before installation of the second half is initiated. Upon completion of construction the channel bottom is backfilled to original contours with clean, compatible sediments.

Because the cofferdam will alternately block approximately one half of the Fort Point Channel, there will be temporary changes in tidal current velocities in the immediate area of the cofferdam. However, these changes are minor and will not result in bottom scouring. Tidal excursion will essentially be as described in the previous section.

Sediment disturbance associated with sheet pile driving will be minimal, partly due to the cohesive nature of the bottom sediments and partly due to the downward entrainment of sediments during such activities. However, during construction it will be necessary to continually pump seepage water from within the cofferdam. Because of the ongoing excavation, this water will be turbid and contain high levels of suspended solids. In order to reduce the impact upon water quality from discharge of this water to the Fort Point Channel, the water will first be detained in portable tanks on land prior to discharge. The use of one or two tanks for this purpose will allow sufficient settling so that the water can be discharged to the channel without undue impact.

The cofferdam construction method would have no significant impact on the migration of anadromous fish, and hence dredging moratoriums may not be applicable. Similarly, because the cofferdam alternative does not result in a change in the availability of suitable quantities of water for any of the four local users, there will not be any impact on their ability to pump adequate volumes of water. Finally, the lack of turbidity associated with open water dredging will allow continuous operation of all seawater users.

Sediment dewatering and disposal would be subject to the same conditions as those described for the open water dredging method of crossing the channel.

5.8.3.2 Groundwater and Stormwater Control

Due to the generally shallow groundwater levels in the project area (less than 10 feet below the surface), and as the result of normal, construction site stormwater accumulation, some dewatering of the Transitway excavations will be required during construction. Steps will be taken to minimize dewatering in order to prevent drawdown of the existing groundwater table and to reduce the amount of groundwater and stormwater discharged to surface waters. Groundwater and stormwater discharge minimization measures are summarized below for the Full Build and MOS-2 Transitway Alternatives.

Based on the anticipated dewatering rates presented below, no groundwater injection is anticipated. Discharge of pumped groundwater to local storm drains will be subject to National Pollution Discharge Elimination System (NPDES) permit review by EPA and a dewatering permit from the Boston Water and Sewer Commission (Article II, Section 8 of the Commission's Sewer Use Regulations). These permitting processes will establish control measures necessary to prevent water quality impacts to the downstream receiving waters. The storage/maintenance facility which would be needed under each Transitway Alternative would be subject to construction and post-construction NPDES permits, as described for the similar facility proposed as part of the Bus/TSM Alternative (see Chapter 5, Section 5.8.2).

Full Build Alternative, Boylston Station to South Street

The turnaround loop at Boylston Station will be mined tunnel, with grouting employed at the tunnel face as necessary to stabilize the sands and minimize groundwater inflow. Some localized seepage is anticipated, however. A horizontal drainage probe will be installed through the grouted face to relieve hydrostatic pressure on the grouted zone.

At Boylston Station, lateral seepage into the station excavation will be precluded by concrete diaphragm walls, and by grouted cutoffs beneath the Green Line. These seepage cutoffs will extend into a layer of dense glacial-marine sediments of low hydraulic conductivity located below the base of the excavation. However, approximately three temporary dewatering wells may be required at the south end of the station during cutoff installation, in order to allow it to occur from within the station. The anticipated groundwater withdrawal rate during construction of the turnaround loop and Transitway platforms at Boylston Station is estimated at 20 gal/min. As all construction occurs in mined or existing tunnels, no stormwater controls will be required.

Concrete diaphragm walls will be used for excavation support along the Transitway alignment from Boylston Station to Chinatown Station and for the excavation at Chinatown Station. These walls will extend into a layer of dense glacial-marine deposits of low hydraulic conductivity. The minor seepage which is expected to occur into the base of the excavation will be controlled by drainage trenches and sumps.

Temporary dewatering wells will be installed adjacent to the existing Orange Line on the north and south sides of the Transitway excavation as it advances beneath the Orange Line. These wells are necessary to intercept groundwater at locations where the Orange Line prevents slurry wall installation. Approximately three wells will be located on the north side of the Transitway alignment, while approximately four wells will be located on the south side. The groundwater withdrawal rate within this section of the alignment is estimated to be 45 gal/min. Stormwater from areas adjacent to the cut and cover alignment will be precluded from entering the work area through the use of surface berming. Water falling on the construction cover will be controlled in a manner similar to that of intercepted groundwater.

Finally, the mined tunnel extending from Chinatown Station to South Street will be excavated in clay of very low hydraulic conductivity. The tunnel lining will be installed as the excavation proceeds. Should sand lenses producing significant groundwater inflow be encountered, they will be grouted in order to stabilize the sands and minimize inflow. A horizontal drainage probe will be installed through the grouted face to relieve hydrostatic pressure on the grouted zone. The anticipated groundwater withdrawal rate for this portion of the Transitway is estimated to be 5 gal/min. Since this section will be mined, stormwater control will not be necessary.

MOS-2, Sleeper Street to New Congress Street

Concrete diaphragm walls will be used for excavation support along the Transitway alignment from Sleeper Street to the east side of Courthouse Station. These walls will extend through a thick clay layer located beneath the base of the excavation. Only minimal seepage (approximately 5 gal/min) is anticipated through joints between wall sections, and no seepage is anticipated through the base of the excavation. The seepage will be controlled by drainage trenches and sumps within the excavation.

Excavation from the east side of Courthouse Station to New Congress Street will be supported by sheetpile walls extending into a thick clay layer beneath the base of the excavation. Little to no seepage is expected to occur through the base of the excavation. Some lateral seepage will occur through the sheetpile interlocks. This seepage will be controlled by drainage trenches and sumps within the excavation.

As in the Full Build alignment between the Boylston and Chinatown Stations, stormwater from areas adjacent to the cut-and-cover alignment will be precluded from entering the work area through the use of surface berming. Water falling on the construction cover will be controlled in a manner similar to that of intercepted groundwater.

5.9 SEDIMENT DISPOSAL

Sediment volumes to be excavated under the various project alternatives vary greatly from virtually none for the No Action Alternative to approximately 637,500 cubic yards in the Underground Transitway Full Build Alternative. Construction of any of the Transitway Alternatives could involve a combination of cut-and-cover excavation, tunneling, and dredging. All Transitway Alternatives require dredged crossings of the Fort Point Channel by dry or submerged cofferdam methodologies.

A discussion of estimated dredged and excavated sediment volumes and dredging methods is presented below. Note that, as proposed, the portion of the Transitway alignment along Atlantic Avenue (CC01, CC02A, CC15) would be constructed jointly with the northbound Central Artery. Since excavated material along this section of the alignment would be handled and disposed of as part of the CA/T Project, it is not included in the following discussions.

5.9.1 No Action Alternative

No new tunnels, maintenance facilities, or other construction requiring significant excavation would result from the implementation of this alternative. Therefore, sediment reuse and disposal would not be required.

5.9.2 Bus/TSM Alternative

No new tunnels or alignment-related construction activities requiring significant excavation would result from the implementation of this alternative. The construction of the maintenance facility and the three passenger facilities would require the grading and excavation of an unknown, but presumably minor quantity of material. Excavations would be associated with the placement of foundations/footings and the construction of sub-grade repair bays and equipment pits. The excavated material can be expected to be comprised primarily of fill, the quality of which is unknown.

5.9.3 Underground Transitway Alternatives

The construction of any of the Underground Transitway Alternatives would involve the excavation and removal of sediments through cut-and-cover, tunneling, dredging, and surface grading activities. Depending upon the alternative and the construction methods, the amount of material to be excavated and disposed of is estimated to be between 184,500 and 637,500 cubic yards. Specifically, MOS-1 is estimated to generate 184,500 cubic yards, MOS-2 approximately 396,500 cubic yards, and the Full Build Alternative approximately 637,500 cubic yards of excavated material. These estimates are based upon design drawings prepared for the alternatives using the following assumptions:

- ***Cut-and-cover sections are filled to average existing ground level;***
- ***Tunnel excavation widths are approximately 40 feet; and***
- ***Excavated material from the section of the Transitway tunnel that would be jointly constructed with the northbound Central Artery will be handled and disposed of as part of the CA/T Project.***

The above estimates reflect the displaced volume of sediment only. Actual disposal volumes may be as much as 25 percent higher due to the sediment decompaction that occurs during excavation.

Sediment volumes were further characterized by sediment type and quality, so that potential disposal and reuse options could be identified. Based on the results of the drilling and testing program described in Chapter 3, Section 3.8, the following sediment types were identified:

Clean Fill	***Any non-native gravel, sand, silt, or clay material that is free of wood, bricks, plastic, or other anthropogenic materials, and is below Massachusetts Contingency Plan (MCP) regulatory standards as defined in 310 CMR 40.0361 and 31 CMR 40.1600, is classified as clean fill.***
Contaminated Fill	***Any non-native gravel, sand, silt, or clay material that is free of wood, bricks, plastic, or other anthropogenic materials, and is above MCP regulatory standards, is classified as contaminated fill.***
Miscellaneous Fill	***Any non-native gravel, sand, silt, or clay material that also contains wood, bricks, plastic, or other anthropogenic materials is classified as miscellaneous fill. This material may contain limited quantities of regulated material.***
Sand	***Sediments in which more than 50 percent of the material is of a size larger than that passing through a No. 4 (4.75 mm) sieve. Sands may be further classified based on the percentage of fines as measured with a No. 200 (0.075 mm) sieve.***
Silt	***Sediments in which the 50 percent or more of the material passing through the No. 200 sieve is non-plastic and exhibits little or no strength when air-dried.***
Clay	***Sediments in which the 50 percent or more of the material passing through the No. 200 sieve is plastic within a certain range of moisture content, and which exhibit strength when air-dried. May include land-based or channel-derived sediments.***
Ocean Muck	***Organic silts and other surficial deposits in the Fort Point Channel, typically contaminated with metals, TPH, and PAHs.***

Minor amounts of gravel, peat, and organic matter were also identified as part of the soil characterization process.

Table 5-16 presents the approximate anticipated volumes of each type of material to be excavated for construction of the MOS-1, MOS-2, and Full Build Transitway Alignments.

Based on the physical and chemical characteristics of the sediment categories described above, various options for sediment reuse and disposal were investigated, and are discussed in sections 5.9.3.1 through 5.9.3.6 below. For much of the above material, multiple options for disposal/reuse exist. Ocean-derived clay, for example, may be suitable for ocean disposal, and may also be suitable for reuse as landfill liner, cover, or capping material. Similarly, the "sand" portion appears suitable for project backfill reuse as well as landfill cover material.

5.9.3.1 Hazardous Materials Disposal

Excavated materials classified as a hazardous waste must be disposed of separately from other fill and native sediments according to the requirements set forth in the Massachusetts Hazardous Waste Regulations (310 CMR 30.00) and federal Resource Conservation and Recovery Act (RCRA) regulations. Materials failing tests for ignitibility, corrosivity, reactivity, or toxicity are classified as a hazardous waste. Potential hazardous wastes are currently tested for toxicity with the Toxicity Characteristic Leaching Procedure (TCLP). Any waste that exhibits one or more of the four characteristics must be disposed of in an approved, licensed disposal facility. In addition, Massachusetts also prohibits the in-state disposal of materials with polychlorinated biphenyls (PCB) concentrations in excess of 2 parts per million (ppm). Limits on polynuclear aromatic hydrocarbons (PAHs) of 300 ppm have also been applied previously in Massachusetts.

TABLE 5-16: EXCAVATE MATERIAL VOLUMES

	MOS-1	MOS-2	Full Build
Clean Fill	23,250	68,100	68,100
Contaminated Fill	8,500	8,500	8,500
Miscellaneous Fill	48,550	85,100	146,700
Sand	3,700	40,200	132,700
Silt	11,900	25,000	45,900
Land-Derived Clay	36,600	117,600	183,600
Ocean-Derived Clay	35,000	35,000	35,000
Ocean Muck	17,000	17,000	17,000
Total	184,500	396,500	637,500

As described in Chapter 3, Section 3.8, of the samples collected during the alignment soil testing and characterization program, only one failed TCLP testing (for lead), while one soil sample was found to have elevated levels of acetone. These samples were collected from borings number 19 and 20, respectively, both of which were installed along an alignment option that is no longer under consideration. In that no hazardous materials were encountered in any of the other program borings, no volume of excavate requiring hazardous materials disposal has been calculated for alignment sediments. However, it is likely that localized areas of contaminated sediments are present on the alignment, and that a portion of the excavated material will require disposal as a hazardous waste. Based upon the proximity to several DEP-listed release sites and the results of studies conducted in the vicinity of the proposed maintenance facility, a portion of the fill material (approximately 8,500 cubic yards) is likely to require disposal as a hazardous waste.

Materials containing virgin petroleum product with TPH levels up to 60,000 ppm may be recycled at in-state asphalt batching plants. Current regulations require that the material passes TCLP testing for metals, and contains less that 2 ppm PCBs. Up to 1 ppm volatile organic compounds (VOCs) may be permitted by DEP in some cases. Hot and cold mix asphalt are produced with a mixture of oily soil and clean aggregate, and will stabilize hydrocarbon soil contaminants in the asphalt process. The percent of fine materials and the moisture content of the excavated materials will partly determine if the materials are appropriate for asphalt batching. Depending on the material available at the batching facility for mixing with project excavate, material with up to 40 percent fines may be acceptable for asphalt batching. Soils may be prepared for asphalt production through the addition or removal of coarse material and the addition of dry sediments.

TPH levels up to 13,400 ppm were detected in the upper 5 feet of ocean mucks from the Fort Point Channel. With appropriate dewatering and soil handling practices, the approximately 17,000 cubic yards of this material anticipated for each Transitway alternative may be suitable for asphalt batching. Material must pass the EPA paint filter test and contain no free liquids in order to be transported for asphalt batching. In addition, localized areas of oil-contaminated soils may be present along the alignment, particularly in the vicinity of Chinatown Station and World Trade Center Station, where somewhat elevated levels of TPH were detected during the soil characterization program.

5.9.3.2 Ocean Disposal

Disposal of material into ocean waters is regulated at the federal level by EPA and the Army Corps of Engineers (ACOE), pursuant to Sections 102 and 103 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended, 33 USC 1401 et. seq. ("MPRSA"). The EPA designates sites for ocean disposal, and the ACOE regulates the transportation of dredged material for the purpose of ocean dumping. At the state level, dredge material disposal is regulated under 314 CMR 9.00, "Certification for Dredging, Dredged Material Disposal and Filling in Waters."

On August 10, 1993, the EPA issued a final rulemaking designating the Massachusetts Bay Disposal Site (MBDS) as a dredged material disposal site. The site is located approximately 22 nautical miles offshore of Boston and is 2 nautical miles in diameter. Its center coordinate is at 42-25.1'N and 70-35.0'W, which is approximately one nautical mile westward and one-half nautical mile southward of the previously designated Massachusetts Bay interim disposal site. The site has been used for ocean disposal activities since the 1940s.

In accordance with the final rulemaking, disposal at the MBDS is limited to clean dredged material only. The term "dredged material" means any material excavated or dredged from the navigable waters of the United States. Acceptability of the dredged material is evaluated by ACOE in light of the EPA Ocean Dumping Criteria (40 CFR 227 and 228). This evaluation is based on a tiered approach which utilizes chemical characterization of the sediments for initial screening, but relies heavily on biological bioassay and bioaccumulation testing, as well as compatibility of the dredged material with sediments in the disposal area.

Based on the sediment characterization data presented in Chapter 3, Section 3.8, the contaminant levels found in the organic surface sediments that would be dredged from the Fort Point Channel during construction of any of the Transitway Alternatives would preclude their acceptability for ocean disposal. The relatively uncontaminated subsurface sediments, however, may be suitable for disposal at the MBDS, subject to satisfactory biological testing. These sediments constitute approximately 35,000 yards of material under all Transitway alternatives.

In addition to the above subsurface sediments of the Fort Point Channel, some of the native marine clays underlying historic fill areas along the Transitway corridor, particularly to either side of the channel and in the South Boston area, may be suitable for disposal at the MBDS. This is virgin material which would be excavated from historic tidelands after the overlying fill layer is removed. In order for this material to be approved for disposal at the MBDS, the MCZM, ACOE, and EPA would need to agree to redesignate it as dredged material, and it would be subject to further chemical and biological testing to ensure that it would meet the Ocean Dumping Criteria. For the CA/T Project, almost 500,000 cubic yards of similar material excavated from historic tidelands in the land approaches at either end of the Third Harbor Tunnel was redesignated as dredged material and has since been disposed of at the MBDS.

5.9.3.3 Project Backfill

The Massachusetts Department of Public Works, "Standard Specifications for Highways and Bridges" defines specific physical requirements that must be met for excavated material to be classified as project backfill ("soil borrow"). These physical requirements encompass the material's moisture content, grain size distribution, total organic carbon, and Atterberg Limits.

In addition to having specific physical requirements, backfill material must be free of significant levels of contamination. The proposed backfill material cannot be classified as a hazardous waste under the Massachusetts Contingency Plan regulations, 310 CMR 40.0000.

Based on the physical and chemical characteristics determined by the project test boring program, most of the "sand" encountered in the Transitway alignment meets the general criteria for backfill (see Chapter 3, Section 3.8.4., and Chapter 5, Table 5-16). As such, it is estimated that the majority

of the sand excavate can be reused as project backfill. The total estimated volume of excavate material available for reuse as project backfill is 40,200 cubic yards in the MOS-2 alternative, and 132,700 cubic yards in the Full Build Alternative. Little to none of the material excavated under MOS-1 would likely be suitable for reuse as project backfill.

In order for the sand material to be reused as project backfill it must first go through a series of handling processes. These processes include proper excavation methods to keep this material separate from the other excavate material, and additional sorting and subsequent storage at a designated storage facility. The sorting is required to separate out different types of backfill material and the materials not suitable for backfill. The material must be stored until such time that it is needed on the project.

5.9.3.4 Landfill Reuse and Disposal

Much of the anticipated Transitway Project excavate meets the requirements for reuse or disposal in local landfills. Reuse option includes the use of excavate material as either daily cover, intermediate cover, grading material, or as final capping material. These reuse options have specific physical and chemical requirements. For those materials that do not meet these reuse requirements, but are not classified as hazardous waste, do not meet the requirements for reuse as project backfill, and/or do not meet the requirements for ocean disposal, disposal at local landfills may be appropriate. These types of materials include rebar, bricks, demolition debris, and similar miscellaneous fill material. However, there are restrictions on the disposal of these types of material as well. The requirements for excavate reuse and the restrictions on excavate disposal at local landfills are reviewed below.

Landfill Reuse

The options for reuse of project excavate at landfills include daily and intermediate cover, grading or reshaping material, and final capping and/or liner material. The physical requirements for landfill cover and grading material are based upon the sediment classification categories established by the Unified Soil Classification System.

According to the Massachusetts Solid Waste Management Facility regulations (310 CMR 19.130 [15]), landfills are required to cover refuse with 6 inches of "daily cover" material that will maintain a physical separation of the solid waste from the surface environment, be substantially odor free; consist of materials suitable for carrying out the geotechnical and other functions of the cover material; and control fires, vectors, the occurrence of nuisance conditions such as odors or litter, and be placed in a manner so as to minimize erosion by wind and/or water. Any area of the landfill that has not received waste within the previous thirty days must receive a minimum of 6 inches of "intermediate cover," in addition to the daily cover, on the top and slopes of the landfill. Any area of the landfill that has not received waste within six months or longer, shall receive a minimum of one foot of material, in addition to the daily cover, on the top and slopes of the landfill. Material to be used for grading and reshaping of the landfill in preparation for the final cover shall be of similar characteristics as that of the daily and intermediate cover material. Finally, landfill closure actions must utilize 18 inches of compacted final capping and liner material that has an in-place, saturated hydraulic conductivity of 10^{-7} cm\sec.

Based on the above criteria, it is anticipated that the excavate material identified as clean fill, sand, silt, land-derived clay, and ocean-derived clay in Table 5-16 can be reused at local landfills in Massachusetts. Specifically, all of the above can be utilized for daily, intermediate, and final landfill cover material, while the clay components can also be utilized for liner or final capping material.

Under the MOS-1 Alternative, 110,450 cubic yards of excavate material will be available for landfill reuse. This represents 60 percent of the total anticipated excavate volume for this alternative. For the MOS-2 Alternative, these numbers are 285,900 and 72 percent, respectively; for the Full Build

Alternative, the numbers are 465,300 and 73 percent. As discussed above, non-landfill reuse alternatives are available for portions of this material.

Landfill Disposal

Project excavate that is not suitable for reuse at landfills and is not classified as hazardous waste can be disposed of in landfills as solid waste, with limitations. These limitations are that it does not contain hazardous wastes, freely draining liquids, and/or special wastes such as asbestos, unless approved with special handling and treatment conditions (310 CMR 19.130 [3]). In addition, DEP can restrict or prohibit the disposal of certain components of the solid waste stream if the disposal of the material presents a potential adverse impact to public health, safety, or the environment; or a restriction will result in the extension of the useful life capacity of a facility.

Based on the results of the test boring program described in Chapter 3, Section 3.8, it is anticipated that the materials identified as miscellaneous fill in Table 5-16 are suitable for landfill disposal. This is approximately 48,550, 85,100, and 146,700 cubic yards of material under the MOS-1, MOS-2, and Full Build Alternatives, respectively.

5.9.3.5 Anticipated Landfill Sites

Two important components of the availability of future landfill space are the changing regulatory requirements of landfills with regard to closures, and the competition for landfill space with that of other large construction projects such as the CA/T Project. These two issues are discussed below.

Available Sites

Owners and/or operators of both active lined and unlined landfills within a 25 mile radius of Boston were interviewed to determine the anticipated landfill status and excavate demand during the Transitway construction program. This included a total of sixteen private and municipal landfills of various sizes. Eleven additional landfills located between 25 and 100 miles of Boston were also contacted. These eleven landfills were limited to the current largest active landfills in the state, all of which are also lined.

Of the twenty-seven landfills investigated, six either will not be in operation in 1995, do not require additional cover and capping materials, and/or are proposed to receive material from additional sources. Table 5-17 provides the names of the remaining twenty-one landfills, their current status, proposed closure dates, material requirements, lined or unlined status, and distance from Boston.

Previously, the state solid waste management regulations stated that all unlined sanitary landfills must stop receiving waste by January 1, 1994 (310 CMR 16.00 and 19.00). As a result, the majority of owners of unlined landfills contacted have applied for extensions. In several cases, current operating cells will be closed in the near future, with the expansion of the landfill into additional lined cells occurring with DEP approval. The lined landfills will continue to operate until they reach their approved capacity.

A 1993 amendment of Chapter 111, § 150A revised the statutory and regulatory approach to continuing operations at unlined solid waste landfills. The 1993 amendment removed the deadline for closure and substituted a process under which the DEP will classify qualifying landfills into four categories. These categories are based on scientific information and include significant threat, potential threat, no present discernable threat, and inconclusive data. On October 21, 1993, the DEP published a draft list of the affected landfills and their classifications. Each municipality has until February 1994 to submit additional information to the DEP and request reclassification. Sites classified as a significant threat will be required to close based on a schedule negotiated between the municipality and the DEP. Landfills in the potential or no discernable threat categories not subject to the order are obligated to install groundwater monitoring systems by July 1994 and 1995,

respectively. Table 5-17 presents the current site classification for the unlined landfills affected by the new regulations.

The current total annual volume of daily and intermediate cover material required for the twenty-one landfills listed in Table 5-17 is estimated at approximately 900,000 cubic yards. The current annual volume of clay required for partial capping, and the total volume of clay required for final capping of the listed landfills projected to close between 1995 and 1998, is estimated at approximately 206,000 and 719,500 cubic yards, respectively. In addition, there is a need for approximately 280,000 cubic yards of cover material required to reshape the landfills for final closure.

Based on the above, there is both the need and demand for cover and capping materials such as those that would be generated by implementation of any of the Transitway Alternatives. Several of the interviewed landfill operators are currently purchasing material from local contractors, while others are having difficulty locating reliable sources of clean material and are turning to synthetic liners and caps in lieu of the availability of good quality clay.

There is a degree of uncertainty associated with the final DEP classification of the unlined landfills, and the timing of landfill closures relative to the anticipated Transitway construction schedule. If several of the listed unlined landfills are classified by DEP as significant threats, and are therefore required to close in the near future, the demand for clay capping material will increase while the demand for daily and intermediate cover material will decrease. The timing of the Transitway Project relative to other projects and, in particular, the CA/T Project, may also affect demand. Due to the very large volumes of material proposed to be generated during the CA/T Project, competition for landfill space may become a significant issue. Anticipated CA/T Project landfill use was therefore also reviewed, as discussed below.

Central Artery/Third Harbor Tunnel Project

In February of 1993, the Massachusetts Highway Department (MHD) and DEP formalized a Memorandum of Understanding by and between Massachusetts Highway Department and Massachusetts Department of Environmental Protection for the handling and disposal of excavate generated by the CA/T Project. As part of this agreement, Materials Processing Operations (MPO) and chemical criteria and sampling protocols were established. According to the agreement, MPO facilities will handle and process excavate materials for reuse as either project backfill or landfill cover (daily or intermittant), grading, capping, or liner material. Categories of reuse options were established based on chemical concentrations in the excavate and established sampling protocol.

As currently envisioned, the MHD will, with DEP assistance, select specific local unlined landfills to be the recipient of the grading and capping material. Although at this time, the MHD is proposing to use these materials at lined and unlined landfills, the following analysis assumes unlined landfills only, and is based upon consultation with DEP. The goal of the grading and capping project is to reuse this material in such a way that will benefit local communities by providing material at a reduced cost, while improving the environment by assisting in closing unlined landfills that pose a significant threat to public health and the environment. The DEP proposes to select local unlined landfills on the basis of their threat to the environment; the readiness of the municipality to close the landfill (i.e., approved closure plans and funds to perform the closure); the need for both cover for reshaping and grading as well as capping material; the size of the landfill (i.e., the total volume of material required); the availability of storage space at the landfill to maintain excavate until such time that the material shall be applied; the timing of the closure relative to the CA/T Project schedule; the distance to the landfill from the project site; and additional requirements of the MHD and those of the recipient community.

TABLE 5-17: INVENTORY OF LANDFILL DAILY COVER AND FINAL CAPPING VOLUMES[1]

Landfill Name	Classification[2]	Lined	Current Closure Date[3]	Proposed Closure Date[4]	Current Cover Volumes[6]	Anticipated Reshaping Cover Volumes	Current Clay Volumes	Anticipated Clay Volumes[7]	Distance from Boston[5]
Barre	NA	Yes	2005	2005	46,800	Unknown	30,000	Unknown	57
Chicopee-Partyka	NA	Yes	2023	2023	93,600	Unknown	Unknown	Unknown	83
Concord	NA	Yes	1995	1999	5,200	Unknown	Unknown	26,000	19
Easton	P	No	1994	1999	10,400	Unknown	Unknown	64,500	26
Fall River	NA	Yes	2004	2004	100,000	Unknown	Unknown	Unknown	43
Foxboro	P	No	1994	2014	7,800	100,000*	Unknown	130,000	22
Granby	NA	Yes	2008	2008	93,600	Unknown	Unknown	Unknown	78
Hingham	S	No	1994	2000	16,000	Unknown	Unknown	60,000	15
Hudson	NA	Yes	2013	2013	46,800	Unknown	30,000	Unknown	28
Marshfield	P	No	1994	2008	15,000	Unknown	Unknown	25,000	24
Middleton	S	No	1994	1997	5,000	Unknown	Unknown	30,000*	17
Needham	P	No	1994	Unknown	40,000	120,000*	Unknown	120,000*	13
Peabody	NA	Yes	1996	2004	113,000	Unknown	56,000	Unknown	17
Pembroke	NA	Yes	1993	1993	0	60,000*	0	75,000	27
Plainville	NA	Yes	1994	1998	156,000	Unknown	Unknown	Unknown	27
Scituate	P	No	1994	2014	9,582	Unknown	Unknown	105,000*	19
Springfield	NA	Yes	1998	2003	46,800	Unknown	30,000	Unknown	81
Topsfield	S	No	1994	2000	6,500	Unknown	Unknown	78,000	26
Townsend	NA	Yes	1998	2003	46,800	Unknown	30,000	Unknown	42
Wayland	NA	Yes	2001	2001	2,000	Unknown	Unknown	6,000*	17
Westminster	NA	Yes	2018	2018	46,800	Unknown	30,000	Unknown	48
Total Estimated Volumes					907,582	280,000	206,000	719,500*	

1 Volumes of material reported as cubic yards per year (c.y./yr) based on conversations with the current landfill owners or operators.
2 Current DEP landfill classification: S=Significant Threat, P=Potential Threat, NA=Not Applicable.
3 Current anticipated closure date, and/or landfill life expectancy.
4 Proposed closure date with DEP approval, and/or anticipated landfill life expectancy.
5 Distance from Boston in miles.
6 Annual cover volumes includes both daily and intermediate cover material.
7 Clay with a hydraulic conductivity (K) < 10^{-7} cm/sec. Includes capping and liners.
* Estimated volumes provided by the DEP Division of Solid Waste Management.

Preliminary comparisons of in-state landfill material demand and the anticipated volumes of material to be generated by the Transitway Project (Full Build Alternative) and the CA/T Project suggest adequate capacity for suitable material from both projects. Table 5-18 provides the proposed volumes of landfill reuse material anticipated to be generated by the Transitway and CA/T Projects between the years 1995 and 1998. The CA/T Project excavate volumes are compared to those of all the unlined landfills in the state. The Transitway excavate volumes are compared to those of the ten largest lined landfills listed on Table 5-17.

TABLE 5-18: PRELIMINARY COMPARISONS OF LANDFILL CAPACITIES AND EXCAVATE VOLUMES

	Material Type	Volume (c.y.)		Material Type	Volume (c.y.)
CA/T Excavate Volume[1]	Cover	2,237,000	MBTA Excavate Volume[3]	Cover	114,000
	Clay	2,480,000		Clay	183,600
Volume Demand for Unlined Landfills[2]	Cover	3,000,000	Volume Demand 10 Lined Landfills[4]	Cover	790,200
	Clay	4,000,000		Clay	206,000

1 *CA/T Project, October 21, 1993, Recommended Disposal Plan January 1994 through December 1998.*
2 *Preliminary estimates, DEP Division of Solid Waste Management.*
3 *MBTA excavate volumes based on Transitway Full Build Alternative, through 1998.*
4 *Total, annual excavate volume demand for lined landfills listed in Table 5-16.*

The CA/T Project is anticipated to generate approximately 2,480,000 cubic yards of clay between 1995 and 1998. According to DEP preliminary estimates, the total demand for clay to cap all unlined landfills in the state is 4,000,000 cubic yards. As a result, the total projected volume of CA/T Project clay falls significantly short of the overall landfill clay demand.

The CA/T Project is also anticipated to generate over 2,237,000 cubic yards of landfill cover material over the same four year period. According to DEP preliminary estimates, the total demand for landfill regrading material for unlined landfills is 3,000,000 cubic yards; again suggesting adequate landfill demand to accept the suitable CA/T project material.

The total annual demand for cover and clay material for the ten largest lined landfills is 790,200 and 206,000 cubic yards, respectively. The Full Build Transitway Alternative would generate approximately 114,000 cubic yards of cover and 183,600 cubic yards of clay over a four-year period. Hence, there would appear to be adequate in-state capacity to utilize this portion of the excavate from any of the Transitway alternatives.

Although it remains to be seen how many landfills will be classified by DEP as a significant threat, it is likely that the CA/T Project will provide excavate to the majority of unlined landfills within a 25 to 50 miles radius of Boston between 1996 and 1998. Targeting lined landfills for suitable Transitway excavate reuse may reduce the competition for landfill space. It will also be more cost effective to select a few larger landfills which can accept all of the material than to select several smaller landfills, some of which may be closed during the course of the project. Table 5-19 provides a preliminary list of the lined landfills available to receive suitable excavate according to

their current and projected status, their distance from Boston, and their annual projected cover and clay volume requirements.

TABLE 5-19: POTENTIAL LANDFILL EXCAVATE REUSE SITES

Landfill Name	Distance from Boston (miles)	Proposed Closure Date	Annual Cover Volume(c.y.)	Annual Clay Volumes[1]	Storage Space Available
Peabody	17	2004	113,000	113,000	Yes
Hudson	28	2013	46,800	30,000	Yes
Plainville	27	1998	156,000	Unknown	Yes
Fall River	43	2004	100,000	Unknown	Limited
Townsend	42	2003	46,800	30,000	Yes
Westminster	48	2018	46,800	30,000	Yes

1 Unknown volumes assumed to be no less than 30,000 c.y./yr.

An additional benefit to utilizing lined landfills is the preclusion of potential problems relating to elevated levels of sodium from marine sediments. Draft regulations currently under review at DEP suggest that soils disposed of in unlined landfills not have sodium concentrations in excess of 4,000 mg/kg. However, no upper limit presently exists for lined landfills with proper surface water drainage controls. Therefore, disposal in lined landfills would preclude any potential disposal problem associated with excavate having elevated sodium concentrations. None of the samples analyzed in the project sediment characterization program described in Chapter 3, Section 3.8, had sodium levels in excess of 4,000 mg/kg.

5.9.3.6 CA/T Project Excavate Handling and Disposal Coordination

As discussed above, the MHD and DEP have entered into a Memorandum of Understanding (MOU) relating to the management of the CA/T Project material. This agreement defines procedures for handling, testing, treating, and the reuse of project excavate material. Under this agreement, an initial assessment and characterization of the excavate materials is performed under a "Right of Way Assessment and Remediation Service" (ROWARS) contract. Potential hazardous material release sites located on the right of way are investigated and classified according to a set of pre-determined clearance criteria. The sites are then classified as either Clearance or Non-Clearance areas. Special handling and testing procedures are established for each area.

The appropriate handling, transporting, disposal, and reuse for Non-Clearance area materials are established under the CA/T Project ROWARS procedure and the MOU between MHD and DEP. These procedures include criteria for soil testing, excavate reuse and disposal, material tracking, and performing public health risk assessments. The response actions to be taken to assess, contain, treat and/or remove soils and groundwater within Clearance areas are outlined within Clearance Reports established for each Clearance site.

Opportunities for, as well as the need for utilization of a similar, or the same, procedures are to be explored during design of the Transitway Project.

5.10 ARCHAEOLOGICAL RESOURCES

The shape of Boston has been dramatically transformed from its original seventeenth century shoreline defined by the Shawmut Peninsula. A series of extensive landfills throughout the last 150 years has resulted in several new and expanded neighborhoods. The entire Fort Point Channel area and Chinatown, for example, were created from fill as was a large portion of the Leather District. These areas of filled land have low archaeological sensitivity.

Although the western section of the Fort Point Channel Underground Transitway Full Build alignment passes through lands of the original Shawmut Peninsula, nineteenth and twentieth century construction and the ubiquitous nature of the utilities are presumed to have substantially compromised the integrity of any significant archaeological resources that may have once existed in these areas. The sole section of the alignment that may contain significant archaeological resources is the portion of the Boston Common abutting the west side of Tremont Street and Boylston Station. This relatively undisturbed area has a moderate to high potential to contain historic period domestic, human burial, and landscaping remains, as well as the possibility of prehistoric sites.

In the following sections, the construction related impacts on potentially significant archaeological resources are described for each alternative. The investigation of significant resources and assessment of impacts has been coordinated with the State Historical Preservation Officer (SHPO). The SHPO has concurred with the following assessments and has entered into a process Memorandum of Agreement ***(MOA) with the Federal Transit Administration (FTA) and the Advisory Council on Historic Preservation which stipulates the need*** for later subsurface investigations at Boston Common. These investigations would be required prior to construction of the Full Build Alternative. ***This MOA is contained in Appendix A to this document. A Section 4(f) Evaluation will be completed prior to the completion of final design, concurrent with with reviews stipulated under the MOA.***

5.10.1 No Action Alternative

The No Action Alternative would involve no construction or ground surface disturbing activities. Therefore, it would have no impact on any potentially significant prehistoric or historic archaeological resources within the project area.

5.10.2 Bus/TSM Alternative

The Bus/TSM Alternative would involve only minor construction or ground surface disturbing activities and would have no impact on any potentially significant prehistoric or historic archaeological resources within the project area. The storage/maintenance facility and South Boston passenger facilities sites would be located in an area of filled land. Since the filled land mass areas are not expected to contain significant archaeological deposits, the facilities would have no impact on any potentially significant prehistoric or historic archaeological resources. Erection of a surface passenger waiting facility in the downtown area would not entail significant construction nor ground surface disturbance.

5.10.3 Fort Point Channel Underground Transitway/MOS-1 Alternative

The MOS-1 Alternative would require tunnel construction and ground surface disturbing activities from the intersection of Essex and Lincoln Streets in the Leather District eastward across the Fort Point Channel to the vicinity of Pittsburgh Street in South Boston. Land west of Atlantic Avenue is part of the original Shawmut Peninsula; land east of Atlantic Avenue was created by filling during the nineteenth and early twentieth centuries. Intensive development and deep installation of utilities in the historic land areas, along with repeated dredging of Fort Point Channel, indicate that any archaeological resources present in these areas along the tunnel alignment have already been substantially disturbed or destroyed. The filled land mass areas are not expected to contain significant archaeological deposits. Therefore, the MOS-1 Alternative would have no impact on any potentially significant prehistoric or historic archaeological resources within the project area.

5.10.4 Fort Point Channel Underground Transitway/MOS-2 Alternative

The MOS-2 Alternative would require tunnel construction and ground surface disturbing activities from the intersection of Essex and Lincoln Streets in the Leather District eastward across the Fort Point Channel to D Street in South Boston. As noted in Section 5.10.3 above, any archaeological resources present in these areas have previously been substantially disturbed or destroyed. Therefore, the MOS-2 Alternative would have no impact on any potentially significant prehistoric or historic archaeological resources within the project area.

5.10.5 Fort Point Channel Underground Transitway/Full Build Alternative

The Full Build Alternative would result in deep tunnel construction and ground surface disturbing activities from the intersection of Boylston and Tremont Streets in the Midtown District eastward across the Fort Point Channel to D Street in South Boston. Areas between South Station and D Street are not expected to contain archaeologically significant resources. However, the extreme western end of the Full Build Alternative would extend into an area of the Boston Common where potentially significant as-yet-unknown archaeological resources may be preserved. Therefore, the Full Build Alternative may have an impact on potentially significant archaeological resources within the Boston Common, should they exist.

Additional archaeological investigations to determine the location, extent, internal components, temporal affiliation, and significance of any sites existing within this sensitive area will be conducted; ***permits to perform these investigations will be co-signed by the City of Boston Archaeologist.*** These investigations may include additional background research on the Central Burying Ground and subsurface testing in any areas to be impacted by permanent or temporary construction activities, such as dewatering wells. A determination of either No Effect, No Adverse Effect, Conditional No Adverse Effect, or Adverse Effect can be made when the resources and project impacts are known. It is believed that the on-site investigations, which would be slightly disruptive to the Common, would best be performed after a preferred alignment is finalized. The preferable approach would be to perform these investigations immediately in advance of the construction activity.

5.11 HISTORIC RESOURCES

Boston is a city rich in historic resources. Near the alignments of the proposed transit alternatives alone, there are six historic districts and over fifty structures protected by federal, state, and local regulations. These historic resources and regulations were described in Chapter 3, Section 3.10.

Potential impacts were analyzed for structures located within a corridor 300 feet wide along the Transitway alignment in accordance with Section 106 criteria. While no impacts to historic resources are expected as the result of operation of any of the transit alternatives, construction of the Transitway Alternatives would affect resources within the impact corridor. In the following sections, these potential impacts to historic resources and recommended mitigation measures are described for each alternative. These impacts and proposed mitigations have been reviewed with the SHPO. Historic resources as documented and discussed in Chapter 3, Section 3.10, are underlined for identification in the following sections. Given their similar alignments and potential impacts, the two MOS Alternatives are discussed together.

The findings of effect are summarized in Table 5-20 and have been reviewed with the SHPO, who has concurred with these findings and the proposed mitigation. The SHPO has made a determination of effect for the entire proposed project, due to concerns with project segmentation under the regulations of Section 106 of the National Historic Preservation Act.

A process MOA has been developed between the FTA, MHC (in its capacity as the SHPO), and the Advisory Council on Historic Preservation, with concurrence by the MBTA and the Boston Landmarks Commission. This agreement, which is included as Appendix A to this document, stipulates the measures that will be carried out to mitigate impacts to historic/archaeological

TABLE 5-20: FINDINGS OF EFFECT ON HISTORIC RESOURCES IN THE VICINITY OF THE SOUTH BOSTON PIERS/FORT POINT CHANNEL TRANSIT PROJECT

Historic Districts and Properties	Historic Status	Potential Impact			
		No Action, Bus/TSM	MOS-1	MOS-2	Full Build
South Boston Piers/Fort Point Channel District					
1 Fort Point Channel District	NRD-E	NE	AEs	AEs	AEs
granite bulkheads		NE	AEd	AEd	AEd
51 Sleeper Street		NE	AEs	AEs	AEs
44-54 Farnsworth Street		NE	AEs	AEs	AEs
41-46 Farnsworth Street		NE	AEs	AEs	AEs
49-54 Farnsworth Street		NE	AEs	AEs	AEs
42-56 Pittsburgh Street		NE	NE	AEs	AEs
41-47 Pittsburgh Street		NE	NE	AEs	AEs
51 Pittsburgh Street		NE	NE	AEs	AEs
44-48 Stillings Street		NE	NE	AEs	AEs
47-49 Stillings Street		NE	NE	AEs	AEs
2 Commonwealth Pier Five	NR	NE	NAE	NE	NE
3 Fish Pier	NR-E	NE	NAE	NE	NE
4 *Northern Avenue Bridge	NR-DOE	NE	NE	NE	NE
Chinatown/Midtown District					
5 Leather District	NRD	NE	AEs	AEs	AEs
Hotel Essex, 687-95 Atlantic Ave.		NE	AEs	AEs	AEs
705-13 Atlantic Avenue		NE	AEs	AEs	NE
Boston Hide and Leather, 20-24 East Street		NE	AEs	AEs	AEs
66-86 Lincoln Street		NE	AEs	AEs	AEs
6 Textile District	NRD	NE	NE	NE	AEs
Wentworth Building, 90-100 Chauncy Street		NE	NE	NE	AEs
Textile Building, 89-99 Chauncy Street		NE	NE	NE	AEs
Frost Building, 105-11 Chauncy Street		NE	NE	NE	AEs
Chauncy House, 115-17 Chauncy Street		NE	NE	NE	AEs
62-72 Essex Street		NE	NE	NE	AEs
76-78 Essex Street		NE	NE	NE	AEs
73-79 Essex Street		NE	NE	NE	AEs
Pelham Building, 81-83 Essex St.		NE	NE	NE	AEs
Kingston Building, 105-7 Essex St.		NE	NE	NE	AEs
80-86 Kingston Street		NE	NE	NE	AEs
88-100 Kingston Street		NE	NE	NE	AEs
Auchmuty Building, 104-22 Kingston Street	LLp	NE	NE	NE	AEs

TABLE 5-20: FINDINGS OF EFFECT ON HISTORIC RESOURCES IN THE VICINITY OF THE SOUTH BOSTON PIERS/FORT POINT CHANNEL TRANSIT PROJECT

Historic Districts and Properties	Historic Status	Potential Impact			
		No Action, Bus/TSM	MOS-1	MOS-2	Full Build
Kingston Building, 121-27 Kingston Street		NE	NE	NE	AEs
129-131 Kingston Street		NE	NE	NE	AEs
7 Washington Street Theatre District	NRD	NE	NE	NE	AEs
Paramount Theater, 549-63 Washington Street	LL	NE	NE	NE	AEs
*Opera House, 537-41 Washington Street	LL	NE	NE	NE	NE
8 Piano Row	NRD	NE	NE	NE	AEs
Hotel Touraine, 62 Boylston Street		NE	NE	NE	AEs
Little Building, 80 Boylston Street		NE	NE	NE	AEs
Colonial Building/Theater, 96-104 Boylston Street	LLp	NE	NE	NE	AEs
177 Tremont Street		NE	NE	NE	AEs
Oliver Ditson Building, 178-79 Tremont Street		NE	NE	NE	AEs
Boston Edison Electric, 180-82 Tremont Street		NE	NE	NE	AEs
Masonic Lodge, 183-86 Tremont Street		NE	NE	NE	AEs
9 Young Men's Christian Union	NR, LL	NE	NE	NE	AEs
10 Boston Common	NHL, LL	NE	NE	NE	AEc
11 Tremont Street Subway	NHL	NE	NE	NE	AEs
Tremont Street Subway		NE	NE	NE	AEs
Boylston Station (underground)		NE	NE	NE	AEa
Boylston Station headhouses		NE	NE	NE	AEs
12 *Boylston Building, 2-22 Boylston Street	NR, LL	NE	NE	NE	NE
13 *Boston Edison Electric Illuminating Company, 25-39 Boylston Street	NR	NE	NE	NE	NE
14 Liberty Tree District	NRD	NE	NE	NE	NE
*Liberty Tree Building, 628-36 Washington Street	LL	NE	NE	NE	NE
15 *Emerson/Majestic Theatre, 219-21 Tremont Street	LL	NE	NE	NE	NE

TABLE 5-20: FINDINGS OF EFFECT ON HISTORIC RESOURCES IN THE VICINITY OF THE SOUTH BOSTON PIERS/FORT POINT CHANNEL TRANSIT PROJECT

Historic Districts and Properties	Historic Status	Potential Impact			
		No Action, Bus/TSM	MOS-1	MOS-2	Full Build
South Station Area					
16 Russia Wharf Buildings	NR	NE	AEs	AEs	AEs
17 South Station Headhouse	NR	NE	AEs	AEs	AEs
South Station	NR-DOE	NE	AEs	AEs	AEs

Notes: NR: historic property listed in the National Register of Historic Places
NRD: historic district listed in the NR
NR-E: eligible for listing in the NR
NR-DOE: determination of eligibility for listing in the NR
NHL: National Historic Landmark
LL: local landmark
LLp: local landmark, petitioned
NE: no effect
NAE: no adverse effect
AE: potential adverse effect

a: Alteration to historic interior
c: Temporary intrusion of construction operations
d: Demolition and reconstruction
s: Potential settlement resulting from tunnel construction

* Outside the study corridor, but of concern to the Massachusetts Historical Commission and Boston Landmarks Commission.

resources impacted by the project. The MOA includes stipulations that the MBTA employ a Project Conservator to ensure that impacts to historic resources are eliminated, minimized, and/or mitigated, and that such resources will be thoroughly protected during construction; that the MBTA employ an architectural firm with experience with historic architecture to design new elements associated with historic structures; and that further intensive archaeological investigations be undertaken prior to construction in the vicinity of Boylston Station and the Central Burying Ground.

5.11.1 No Action Alternative

The No Action Alternative consists of minimal increases in bus service and would have no impacts on historic resources.

5.11.2 Bus/TSM Alternative

The Bus/TSM Alternative would result in an increase in bus volumes on certain streets in the project area. These increased volumes would have no impacts on historic resources.

There are no historic resources in the vicinity of the proposed surface passenger facilities and storage/maintenance facility, and thus no impacts would occur.

5.11.3 Fort Point Channel Underground Transitway/MOS Alternatives

The only significant impact of the MOS Alternatives to historic resources in the Piers area would be the temporary removal of 80 linear feet of the granite bulkhead walls on either side of the Fort Point Channel at the tunnel crossing points. These walls would be rebuilt after construction (except within the confines of the tunnel). To ensure that the existing appearance and function of the bulkheads are maintained, the walls would be measured and photographed, and the stones marked, carefully removed, and stored in a secure place. Samples of the existing mortar would be collected and analyzed. After construction of the tunnel, the bulkhead walls would be rebuilt on a suitable foundation with appropriate backfill in the same positions as before, with mortar matching the existing in composition and color. There would be no permanent impact to the Fort Point Channel. ***The reconstruction of the granite bulkhead walls is a stipulation of the MOA.***

Steps would also be taken to avoid any settlement impacts of cut-and-cover tunnel construction on the buildings of Sleeper, Farnsworth, Pittsburgh, and Stillings Streets.

Although the Transitway tunnel segment between South Station and Congress Street would be constructed jointly with the northbound Central Artery, protection of the historic resources along Atlantic Avenue, the Hotel Essex, and 705-713 Atlantic Avenue, is the responsibility of the CA/T Project, under the surveillance of the Project Conservator. ***The MOA contains a stipulation that the Project Conservator for the Transitway Project will coordinate activities with the Project Conservator for the CA/T Project. The Russia Wharf Buildings would be underpinned to permit construction of the Transitway tunnel below. The construction of new structural supports for this building will help preserve it for the future.***

5.11.4 Fort Point Channel Underground Transitway/Full Build Alternative

Impacts of the Full Build Alternative on historic resources between South Station and the Piers area are the same as for the MOS Alternatives, as described in the previous section. The extension of the Transitway tunnel from South Station to Boylston Station would also have impacts on historic resources in the downtown portion of the service area. For example, buildings on Essex, Kingston, Chauncy, and Avery Streets, Hayward Place and Avenue De Lafayette are in a zone of potential settlement as a result of deep bore tunnel construction. In addition, the tunnel would be located under a portion of the Textile Building, 89-99 Chauncy Street.

The process of deep tunneling through soil should not cause any significant vibration impacts, but tunneling could cause buildings to settle if proper techniques are not implemented. Dewatering of the excavation could also lead to settlement. To mitigate any potential settlement impacts, the protection of these historic buildings must be a continuing process throughout the design and construction phases. The steps in this process are: identification of historic resources (a process already completed); documentation of the buildings' structure and condition; inspection of the buildings; geotechnical survey; engineering design of tunnel structure for areas close to historic structures; incorporation into construction specifications of standards for vibration, pile driving structure underpinning and bracing, and soil and groundwater monitoring; movement monitoring during construction; and documentation after completion of construction.

As detailed in the MOA, the measures described above for mitigating settlement impacts will be incorporated into the design and construction of the tunnel. As a member of the project design team, the Project Conservator will oversee the development of measures for monitoring and mitigating any adverse effects of construction on standing historic properties. These mitigation measures will be included in the design and construction specifications.

The Transitway's Boylston Station and accompanying turnback loop would be built a full level below the existing Green Line station (a National Historic Landmark) by a combination of cut-and-cover construction below Tremont Street and mining (excavation) below the Green Line station and under the Boston Common (a National Historic Landmark). Impacts of the station project would be temporary and would occur during construction. Specifically, slurry wall construction would occupy two of the four lanes on Tremont Street.

Since a minimum of three lanes are needed for traffic flow at the afternoon peak (because work cannot be done at night due to City of Boston regulations), one lane of traffic would be detoured onto the Lafayette Mall of the Boston Common, around the construction site. The sidewalks of Tremont Street and surface of the Boston Common would be restored after construction.

In order to control groundwater flow from the Boston Common, groundwater cutoff capability must be provided west of Boylston Station by the use of dewatering wells. Dewatering wells would have fewer impacts than would the construction of a slurry wall at this location. The wells would be approximately 3-foot diameter casings with submersible pumps. Pump-power supply cables and discharge hoses would be placed under the sodded surface of the Common to avoid visual intrusion. This is also a Section 4(f) concern and is noted in Section 5.12.5 later in this chapter.

Impacts to the interior of the existing Boylston Station would be limited to the temporary caisson casings to underpin the existing Green Line Station and the permanent openings for stairways extending from the Green Line platforms down to the Transitway Station level. The installation of caissons would penetrate the Green Line station, but caisson placement would avoid existing tracks, columns, and stairways. The outer casings of the caissons would be a temporary feature to be removed following the placement of each caisson. The installation of the caissons would require the use of a mobile drilling rig, which would occupy a secured space on the Lafayette Mall of the Boston Common during construction. Approximately six of the 1960s vintage planters along the western side of Tremont Street would have to be removed, but they would be restored or other landscaping treatment applied in accordance with the Boston Common Management Plan. The MBTA would coordinate this mitigation activity with the SHPO and City of Boston as the design for this section of the Transitway is developed, ***and would utilize the expertise of an architectural firm experienced in historic preservation.***

The vertical circulation elements, including elevators for handicapped access, would be coordinated with the Green Line station rehabilitation and accessibility project. The latter project will coordinate separately with the SHPO. Any impacts to Boylston Station and the adjacent Tremont Street subway will conform to the Secretary of the Interior's Standard for Rehabilitation of Historic Structures. The Boylston Station interior is considered to be historically significant since it has been the least altered of the original Tremont Street subway stations. ***As noted above, the MBTA would employ an architectural firm experienced with historic preservation to ensure that new elements are sensitively and appropriately designed. Another stipulation of the MOA requires that the Project Conservator review all plans developed for the Transitway.***

5.12 PARKLANDS

Due largely to the limited existing parkland in the project area, none of the transit alternatives is expected to have any direct (i.e., land taking) impact. All but the No Action Alternative, however, would have some indirect impacts on either existing or planned parklands. In general, these indirect impacts would be felt as a result of either the presence of fixed facilities or the operation of surface buses.

The indirect impacts on parklands associated with each transit alternative are described below.

5.12.1 No Action Alternative

This alternative results in minimal increases in certain bus services. No fixed facilities are proposed. Therefore, the No Action Alternative would have no impact on parkland and open space usage in the project area.

5.12.2 Bus/TSM Alternative

Surface passenger facilities consisting of shelters, street furniture, bus berths, and pullouts on New Congress Street and New Northern Avenue would reduce public space that has been designated for

landscaping and other boulevard features. Such features are intended to provide visual relief to the developed portion of the Piers area which currently has very little greenery.

The Bus/TSM Alternative would also increase the number of buses on neighborhood streets in the Chinatown/Midtown District. These bus routes either pass by parklands or must be crossed by children and adults enroute to the parks. For example, buses would pass by Tai Tung Park, South Cove Playground, and the Quincy Community School Playground. These playgrounds are very intensely used by pre-school and school-age children. Buses would also pass by North Park and Statler Park. Since these are passive areas primarily used by adults or as viewing areas, high bus volumes would not present a major safety issue. However, these parks as well as those used by children would still be subjected to the noise and exhaust of buses.

Finally, since buses traverse all of the major north-south streets of Chinatown — Harrison, Washington, and Tremont Streets — children and adults headed for the Boston Common, where there are playing fields, could experience safety problems.

Mitigating measures would include the monitoring of bus routes to ensure that bus stops are located in areas where buses do not block intersections or views of street crossings. Particular attention should be given to the crossing of Washington Street when children are going to and leaving Quincy Elementary School. This monitoring could be done in conjunction with the School Department. In general, the MBTA would work closely with the neighborhood organizations in Chinatown to ensure that children will be able to safely reach the neighborhood parks and playing fields.

5.12.3 Fort Point Channel Underground Transitway/MOS-1 Alternative

No parkland would be permanently taken for this alternative. However, access would be negatively affected during construction, and high bus volumes on neighborhood streets might make it difficult for residents to reach parklands.

The use of the Fort Point Channel for recreational boating could be impacted during construction of the Transitway tunnel crossing under the channel. ***Both commercial and recreational boats would be confined to certain channels through the use of temporary buoys. However, at no time would recreational boats be prevented from navigating and mooring in the channel.***

Pedestrian and vehicular access to the waterfront will be maintained during construction. In the Piers area, the Transitway will be constructed with a cut-and-cover method. Temporary walkways and roadways are customarily built over such construction sites, and this will be done in the Piers area. Construction viewing areas along the temporary walkways are often provided so that pedestrians can observe some of the below-surface construction activity. For many pedestrians, these viewing areas are of great interest; being able to see the site under construction adds to the pedestrian experience.

Vehicular access to the waterfront will be maintained although some detours and reroutings will occur. While these detours and reroutings will be identified as construction staging plans are developed, the MBTA will work closely with the BTD to ensure that safe, efficient vehicular and pedestrian access to the waterfront is provided throughout the construction period.

Tunnel construction activity along New Northern Avenue to Pittsburgh Street could result in brief curtailment of visual or pedestrian access to some of the boulevard features; however, such impacts would be temporary in nature. New Northern Avenue and Transitway construction schedules would be coordinated to the greatest extent possible, so as to minimize construction duration and impacts in this area.

Parkland access would continue to be impacted by high volumes of on-street bus operations. Such high volumes could make it difficult to reach Harborwalk and the proposed parks at Fan Pier. Since it is necessary to cross Piers area roadways to reach the waterfront, residents and visitors may be disinclined to use the waterfront park at Fan Pier and Harbor Park because of the extensive traffic and bus volumes.

The 231 buses at peak hours in the high growth scenario on Congress Street between B and D Streets would be incompatible with the development of this roadway as a landscaped boulevard. Catenary installation for the trackless trolley technology option would need to be integrated into the boulevard landscaping.

High surface bus volumes similar to those in the Bus/TSM Alternative would result in increased noise and deteriorated environmental conditions at parklands and open space in the Chinatown/Midtown District. Those parks that would be harder to reach on foot are the same parks described in the previous Section 5.12.2, since bus volumes are the same as those in the Bus/TSM Alternative. In the South Station area, access to the waterfront and to the Federal Reserve Plaza, which is heavily used by downtown office workers at lunchtime, would be hindered by the joint construction activity for the depressed Central Artery and underground Transitway. Red Line access to this area would be slightly impeded during construction of the new Transitway station within the confines of Dewey Square. All of these activities would be closely coordinated with abutters, including the Federal Reserve Building, and would be consistent with mitigation measures established for the depression of the Central Artery. Surface bus volumes would be reduced somewhat in comparison to the Bus/TSM Alternative, but this is not expected to have any measurable impact on parkland usage.

5.12.4 Fort Point Channel Underground Transitway/MOS-2 Alternative

Construction activities associated with the tunnel and underground stations at Fan Pier and the World Trade Center should not interfere with visual and physical access to the spectacular panoramic views available from World Trade Center. Construction impacts at the Fort Point Channel would be the same as for the MOS-1 Alternative as described in the previous section.

Impacts to parklands and open space in the Chinatown/Midtown District and the South Station area would be the same as those described in the previous section for the MOS-1 Alternative.

5.12.5 Fort Point Channel Underground Transitway/Full Build Alternative

Like the MOS-2 Alternative, the Full Build Alternative alignment would be fully underground in the Piers area. Therefore, impacts to area parklands and open space would be minimal. Likewise, impacts to parklands in the South Station area would be the same as for the MOS Alternatives as described above in Section 5.12.3.

The Full Build Alternative alignment would also be fully underground in the downtown portion of the project area. While construction of the Chinatown Station and underground tunnel would not adversely impact parklands or their access, construction of the Boylston Station would temporarily affect both access to and use of a small portion of the Boston Common.

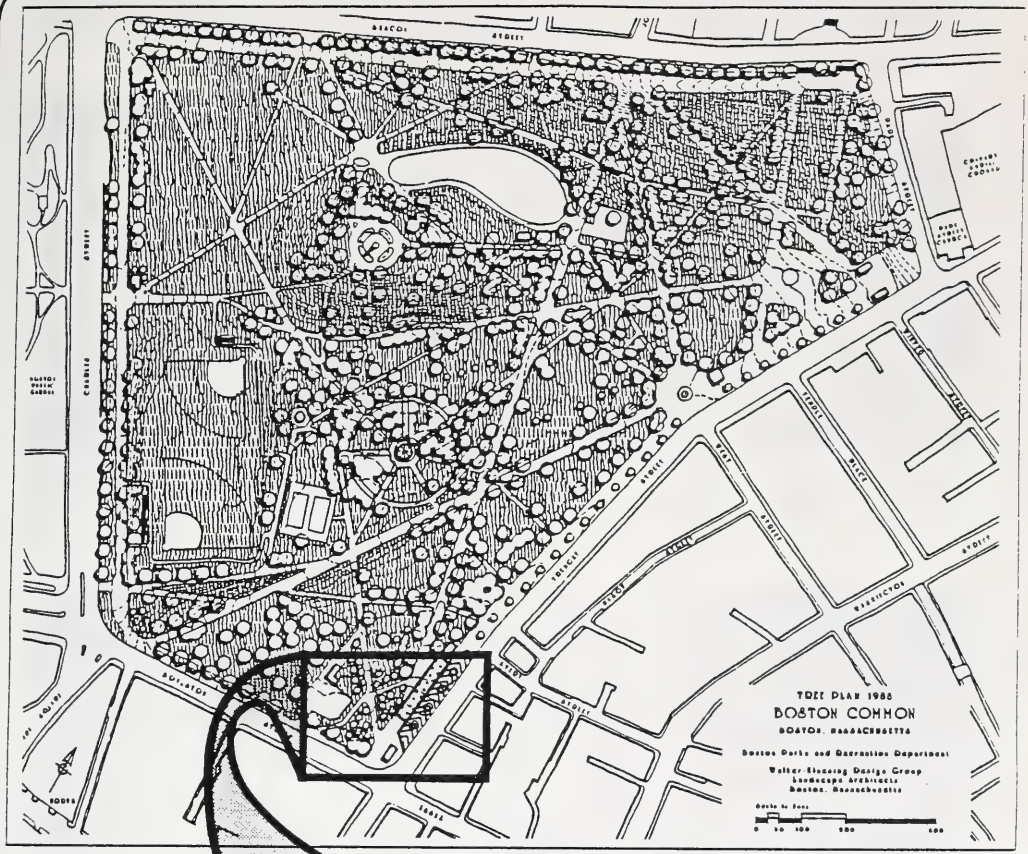
Pedestrian access to Lafayette Mall will be ensured as the new station's design and construction program are further developed. In developing construction programs, the MBTA will work closely with the Boston Parks and Recreation Department as well as BTD. The MBTA has substantial construction experience in intensively used urban areas and is committed to safe, convenient pedestrian and passenger access to the Boston Common and Boylston Station.

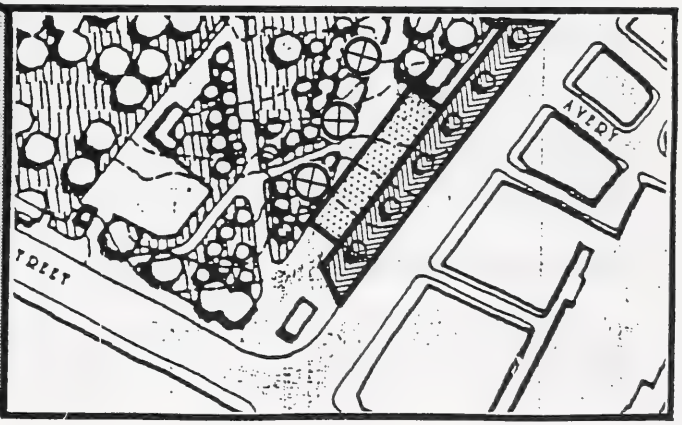
All construction work and staging areas will be fenced off, and the diversion of one lane of traffic onto Lafayette Mall as shown in Figure 5-11 will be accomplished and monitored in close coordination with BTD. As noted above in Section 5.11.4, traffic diversion onto Lafayette Mall is necessitated during the construction of the station slurry wall along Tremont Street. Minor disruption to the Common would also occur during construction of dewatering wells; however, the pump-power supply cables and discharge hoses would be placed under the sodded surface of the Common to avoid visual intrusion.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 5-10
Lafayette Mall





PROPOSED CONSTRUCTION IMPACTS

Key:

- Traffic Detour
- Caisson Placement
- Dewatering Well

The exact amount of affected parkland will be determined only once design is finalized; this design is scheduled for the mid-2000s. However, because the new Transitway station will be constructed one level beneath the existing Boylston Station, construction will occur at a very deep level — approximately 40 feet underground — and will be hand mined. Given this deep construction, ground water levels should not be lowered and the root systems of the few trees in the construction area would not be damaged.

Most of the affected plant life consists of either planters or small shrubs. Restoration of these plants and the Lafayette Mall will be consistent with the Boston Common Management Plan, and the MBTA will work closely with the Boston Parks and Recreation Department and the Boston Landmarks Commission to ensure that there is no permanent damage to the Common. Protection of the Common is a major City of Boston goal in this and other construction projects such as those at Park Station.

5.13 MITIGATION FOR THE LOCALLY PREFERRED ALTERNATIVE

Mitigation during construction and operation of the locally preferred alternative — the Fort Point Channel Underground Transitway Full Build Alternative — is summarized below for each of the impact categories discussed in this chapter. Since implementation of the Transitway will occur in two major phases, and full implementation is not scheduled to be completed until 2008, it is likely that the mitigation measures described below will be refined as the project schedule is advanced.

5.13.1 Neighborhoods, Land Use, and Economic Activity Mitigation

5.13.1.1 Construction

Temporary construction related impacts to neighborhoods and economic activity throughout the project area would be mitigated through the maintenance of pedestrian and vehicular access, provision of appropriate signage, and selection of the least disruptive feasible construction methods and staging. Given that this transit project is intended to foster and support future continued development of the South Boston Piers area and the larger Boston metropolitan region, the MBTA is sensitive to the needs and interests of affected businesses, and has substantial construction experience in dense urban areas.

5.13.1.2 Operation

Perhaps the most significant long-term impact associated with implementation of the Full Build Alternative is its ability to support fully buildout of the Piers area as envisioned by local and regional planners; no other alternative analyzed is able to full support this buildout without associated undesirable environmental impacts.

Underground operation would avoid disruption to neighborhood street life and aesthetic character, while improving access to the waterfront and new jobs in the Piers area, and supporting the social cohesion of the developing residential areas. Although numerous private and public takings/easements would be required to construct the tunnel and subsurface facilities, any existing occupants would be given sufficient time and assistance to relocate, and no economic impact is anticipated.

5.13.2 Energy Impact Mitigation

5.13.2.1 Construction and Operation

Regional energy impacts of the project would be the result of a reduction in automobile travel, offset partially by the energy requirements for construction and operation of the Full Build

Transitway. Since implementation of the Transitway results in energy savings, no mitigation measures are planned or considered necessary.

5.13.3 Aesthetic Impacts Mitigation

5.13.3.1 Construction

Although there would be visual impacts during construction, such impacts would be short-term, lasting only as long as the localized construction activity.

5.13.3.2 Operation

Since the Transitway is an underground system, visual impacts would be limited to a relatively few surface system elements, such as headhouses and station entrances, the tunnel portal, ancillary support facilities, and traction power equipment. Inherent in the trackless trolley technology is the overhead catenary system with its supports and power supply elements. Appropriate design of these elements incorporated into the streetscape can enhance the visual impact. The MBTA is currently working with the South Boston Interagency Streetscape Task Force to integrate surface elements of the Transitway into the future streetscape design for the area. Design treatments will also be stipulated in Transitway construction contracts to minimize the visual impacts of the Transitway portal at D Street, overhead catenary in the eastern Piers area, and storage and maintenance facility.

5.13.4 Air Quality Impacts Mitigation

5.13.4.1 Construction

Any air quality impacts during construction will be localized and temporary. Traffic mitigation measures to be employed are designed to keep traffic flowing in and around construction sites, thereby minimizing idling and congestion which contribute to localized air quality impacts.

5.13.4.2 Operation

As a result of its operation, the Transitway will reduce regional emissions of CO, NMHC, and NOx, will reduce VMT, and will not result in any violations of any CO standards. These air quality benefits are associated with the operation of electric trackless trolley vehicles and with the diversion of automobile trips to transit. Given these air quality benefits, no mitigation is considered necessary.

5.13.5 Noise and Vibration Impacts Mitigation

5.13.5.1 Construction

Mitigation measures that could be implemented to reduce noise levels associated with construction of the Transitway include the following:

- *Limiting construction to normal daytime hours (7:00 a.m. to 6:00 p.m.) in residential areas;*
- *Ensuring that all diesel powered equipment is properly muffled (faulty or ineffective mufflers are major sources of construction noise);*
- *Erecting temporary noise barriers between sensitive receptors and close or noisy construction operations;*

- *Providing specific routes for truck movement to and from construction sites to avoid streets with sensitive receptors;*

- *Limiting removal of muck from the tunneling operation to specific hours; and*

- *Adhering to City of Boston Air Pollution Control Commission (APCC) construction noise ordinances.*

Ground vibration from construction activity is not expected to exceed the criterion limit for structural damage (2.0 in/sec peak velocity) at any building or structure along the proposed alignment. Widespread pile driving is not anticipated during construction, but slurry wall construction is likely. Mitigation action may be required to avoid potential architectural damage at historic buildings adjacent to the slurry wall construction, particularly along Tremont and Avery Streets for the Full Build Alternative.

In terms of vibration annoyance, it is estimated that criteria for buildings may be exceeded at four buildings during pile driving activity that could occur near the Fort Point Channel if the tunnel crossing of the channel is constructed using the cofferdam method. These buildings include Harbor Plaza and Hook Lobster on the downtown side of the channel and the Computer Museum end of the Children's Museum complex and a building owned by Stone and Webster on Northern Avenue on the South Boston side of the channel. It is expected that people working within about 200 feet of the construction site would be annoyed by vibration during pile driving. Pile driving operations would be expected to occur for a maximum of two months, producing building vibration peak velocities of 0.04 in/sec or less; such vibration levels may be characterized as "easily noticeable." Potential methods of vibration mitigation at these sites would include pre-auguring and the use of low-displacement bearing piles.

5.13.5.1 Operation

The Transitway would utilize trackless trolleys. Groundborne vibration and noise generated by underground electric bus operations would be minimal as long as the tunnel floors are maintained in smooth condition.

5.13.6 Ecosystem Impacts Mitigation

5.13.6.1 Construction

Work within and adjacent to the Fort Point Channel and filled tidelands would require state permits, licenses, and/or approvals pursuant to the Massachusetts Wetlands Protection Act, Chapter 91, MCZM, and federal permits pursuant to the Clean Water Act and the Rivers and Harbors Act. Potential short-term environmental factors that would be addressed by these permits and approvals include temporary disturbances to the floodplain, channel banks, and wildlife use of the channel during tunnel construction. These impacts are expected to be minor, and none would extend beyond the construction period. Compliance with Chapter 91 and MCZM as they relate to use and protection of the waterfront and coastal zone is reflected by the improved public access provided by the Transitway.

While construction activities would not cause the significant displacement of existing rodent populations, some localized rodent disturbance is likely. The degree of such disturbance would be related to the amount of habitat disruption either through tunnel excavation activities, demolition of existing structures, or the excavation of new foundations. A rodent control program as outlined in the MBTA's Standard Specifications (1991) will be implemented to mitigate these effects.

5.13.6.2 Operation

If Site A is selected, displacement of water dependent accessory uses by construction of a storage/maintenance facility would be mitigated by relocation assistance.

5.13.7 Water Resources Mitigation

5.13.7.1 Construction

Potential impacts to the water resources of the Fort Point Channel as result of construction of the Transitway would include resuspension of bottom sediments, constriction of channel flow, and decreased navigability. If the modified sunken tube method is used to construct the Transitway across the Fort Point Channel, a number of measures can be taken individually or collectively to mitigate the impacts of increased suspended solids. These include use of closing clamshell dredge buckets; silt curtains; reduced dredging time; alternative seawater sources; and temporary filtration. The use of cofferdams would prevent the turbidity impacts associated with open water dredging. Water quality impacts during construction of the Transitway tunnel across the channel would be limited to minor, localized short-term resuspension of bottom sediments during the placement and removal of cofferdams. One half of the channel would always remain open for tidal flushing and navigation under both construction methods. A channel width of one-half the present size has been shown to be adequate for both flushing and navigational purposes.

Due to the generally shallow groundwater levels in the project area, and as a result of normal, construction site stormwater accumulation, some dewatering of the Transitway excavations will be required during construction. Steps will be taken to minimize dewatering in order to prevent drawdown of the existing groundwater table and to reduce the amount of groundwater and stormwater discharged to surface waters.

Based on anticipated dewatering rates, no groundwater injection is anticipated. Discharge of pumped groundwater to local storm drains will be subject to National Pollution Discharge Elimination System (NPDES) permit review by EPA and a dewatering permit from the Boston Water and Sewer Commission (BWSC, Article II, Section 8 of the Commission's Sewer Use Regulations). These permitting processes will establish control measures necessary to prevent water quality impacts to the downstream receiving waters. The storage/maintenance facility which would be needed under each Transitway Alternative would be subject to construction and post-construction NPDES permits.

5.13.7.2 Operation

Since the Transitway tunnel section within the Fort Point Channel would ultimately lie beneath the bottom of the channel floor, no long-term permanent changes to the existing physical or hydrological characteristics of the channel are anticipated.

At other areas of operations, including the storage/maintenance facility, oil and grease separators would be installed in lines that drain runoff from the site to storm sewers, in accordance with BWSC standards.

5.13.8 Sediment Excavation, Reuse, and Disposal

5.13.8.1 Construction

Construction of the Transitway would result in the generation of approximately 637,500 cubic yards of sediment volumes. Approximately 8,500 cubic yards are likely to require disposal as a hazardous material; approximately 35,000 cubic yards of material would be suitable for ocean disposal at the Massachusetts Bay Disposal Site; an estimated 132,700 cubic yards would be suitable for reuse as

project backfill; and the remainder would meet the requirements for reuse or disposal in local landfills.

5.13.8.2 Operation

No long-term permanent impacts would be generated by implementation of the Transitway in this impact category.

5.13.9 Historic and Archaeological Resources

5.13.9.1 Construction and Operation

A Memorandum of Agreement (MOA) has been prepared between the FTA, MHC (in its capacity as the SHPO), and the Advisory Council of Historic Preservation, with concurrence by the MBTA and the Boston Landmarks Commission. This agreement establishes measures intended to avoid, minimize, and/or mitigate impacts to historic and archaeological resources, including the following:

- *Prior to alteration of any significant properties, a historic survey will be conducted to document the pre-alteration condition of the property.*
- *A Project Conservator shall be appointed to the project design team by the MBTA to ensure that adverse construction impacts on all historic properties are identified early in the project design stages, and are either avoided, minimized, or mitigated through appropriate preliminary and final design solutions.*
- *An architectural firm with experience with historic preservation shall be appointed to the project design team by the MBTA to assist in the design of building elements associated with the project that affect historic resources.*
- *The granite bulkhead walls on either side of the Fort Point Channel at the Transitway tunnel crossing points shall be reconstructed in such a manner as to ensure that the existing appearance and function of the bulkheads are maintained.*
- *The interior of Boylston Station shall be rehabilitated following construction of the project in conformance with the Secretary of the Interior's Standards for Rehabilitation of Historic Structures.*
- *Further intensive archeological investigations shall be undertaken prior to construction in the vicinity of Boylston Station and the Central Burying Ground.*

5.13.10 Parklands Impacts Mitigation

5.13.10.1 Construction

Pedestrian and vehicular access to the waterfront will be maintained during construction. Temporary walkways and roadways over construction sites will include viewing areas so that pedestrians can observe some of the below-surface construction activity. For many pedestrians, these viewing areas are of great interest; being able to see the site under construction adds to the pedestrian experience.

Vehicular access to the waterfront will be maintained although some detours and reroutings will occur. While these detours and re-routings will be identified as construction staging plans are developed, the MBTA will work closely with the BTD to ensure that safe, efficient vehicular and pedestrian access to the waterfront is provided throughout the construction period.

Pedestrian access to Boston Common and the Lafayette Mall will be ensured as the new station's design and construction program are further developed. In developing construction programs, the MBTA will work closely with the Boston Parks and Recreation Department as well as BTD. The MBTA has substantial construction experience in intensively used urban areas and is committed to safe, convenient pedestrian and passenger access to the Boston Common and Boylston Station.

All construction work and staging areas will be fenced off, and the diversion of one lane of traffic onto Lafayette Mall will be accomplished and monitored in close coordination with BTD. This traffic diversion is necessitated during the construction of the station slurry wall along Tremont Street. Minor disruption to the Common would also occur during construction of dewatering wells; however, the pump-power supply cables and discharge hoses would be placed under the sodded surface of the Common to avoid visual intrusion.

Because the new Transitway station will be constructed one level beneath the existing Boylston Station, construction will occur at a very deep level — approximately 40 feet underground — and will be hand mined. Given this deep construction, ground water levels should not be lowered and the root systems of the few trees in the construction area would not be damaged.

Most of the affected plant life consists of either planters or small shrubs. Restoration of these plants and the Lafayette Mall will be consistent with the Boston Common Management Plan, and the MBTA will work closely with the Boston Parks and Recreation Department and the Boston Landmarks Commission to ensure that there is no permanent damage to the Common. Protection of the Common is a major City of Boston goal in this and other construction projects such as those at Park Station.

5.13.11 Traffic Impacts Mitigation

For all areas of construction traveled by the public, detailed traffic maintenance plans will be developed and implemented by the MBTA's designers and construction contractors. All plans and measures to be adopted will be the result of ongoing coordination with the BTD and other city and state agencies having jurisdiction. In areas of joint construction with the CA/T Project, mitigation measures will be consistent with provisions specified by that project. All provisions for access will comply with applicable regulations relative to persons with disabilities, including Americans with Disabilities Act guidelines.

In locations where Transitway construction is to be integrated into existing MBTA facilities (i.e., South Station and Boylston Station), special mitigation measures will be adopted. A partial summary of the measures to be specified is provided below.

5.13.11.1 Dewey Square

The MBTA and MHD have cooperated in integrating the construction of Transitway and CA/T Project elements in Dewey Square. Coordinated construction planning of the two projects would result in the simplification of a very complicated mitigation program in Dewey Square as follows. This traffic maintenance plan is being developed by the CA/T Project.

- *Intermediate traffic phases will be reduced;*
- *Pedestrian impacts will be reduced; and*
- *There will be no temporary traffic decks over the station.*

Traffic and pedestrian phases for the integrated projects include the following parameters:

- *Pedestrian access from the Financial District to Dewey Square is maintained for all phases.*

- *Pedestrian crosswalks at Dewey Square are provided for all four (east, west, north, and south) corners during all phases.*

- *A minimum of three kiosks will remain open during all phases of construction if possible. It should be noted that the South Station headhouse means of access/egress will be open at all times.*

- *A minimum of three lanes, including two through lanes and one right-turn lane, are maintained at Atlantic Avenue north at all times.*

- *A minimum of two lanes in each direction is maintained along Summer Street during all phases.*

- *All pedestrian crosswalks and access/egress locations will be handicapped accessible.*

Planners have noted that a temporary bridge and observation deck may be necessary to address vehicular traffic and pedestrian management issues in Dewey Square during construction. The volume of pedestrian flow through Dewey Square is one of the highest in the city. The bridge would facilitate pedestrian flow across Dewey Square between South Station, 175 Federal Street, and Summer Street by avoiding intense construction activity affecting access to South Station, while work on the MBTA's Transitway station and/or CA/T Project is underway. The bridge would be in service for five years coterminus with the construction period for these two projects in Dewey Square.

Section 106 Considerations: South Station is presently listed on the National and State Registers of Historic Places. The listing applies only to the exterior of the building. Presently at conceptual design level, the proposed bridge would conform to the Secretary of the Interior's Standards for Treatment of Historic Properties in that it would (1) maintain the integrity of the building's historic characteristics; (2) it would provide a contrast between the original construction and new work; and (3) it would be reversible as the bridge would/can be removed at the end of the six year construction period.

Section 4(f) Considerations: The bridge is considered temporary in the context of the larger CA/T Project which is forecasted for completion in 2004. Its projected life of five years beginning in 1994 would end prior to completion of the larger project.

The bridge would not result in a change in ownership or use of South Station. The goal of the pedestrian bridge is to ensure that Dewey Square would remain the primary access for users of South Station, especially commuters.

Lastly, there would be no temporary or adverse changes to activities, features, or attributes of South Station. The bridge would be designed to respect and avoid change to the attributes of South Station which make it eligible for listing as an historic building. The design would be compatible with the historic material and characteristics of the station.

The bridge would be wheelchair accessible at both ends of the structure by elevators located at South Station and Federal and Summer Streets. The determination of whether the bridge will in fact be constructed as a mitigative measure will occur during the final design phase.

5.13.11.2 South Station

South Station reconstruction encompasses all construction necessary to incorporate a Transitway stop into the existing South Station transit station serving the MBTA Red Line. The reconstruction of the transit station entails the demolition of the existing lobby; construction of a Transitway

platform and ancillary facilities; construction of a new lobby serving both the Transitway and Red Line; new internal circulation; and new station finishes. The four surface kiosks serving the Red Line and located in the four quadrants of Dewey Square will eventually allow access to the Transitway as well.

Construction will occur in five areas of Dewey Square. The five areas can be viewed as the four quadrants of Dewey Square plus an additional area more central to the Square itself. Surface construction requiring relocation of pedestrian and vehicular traffic will occur in only one area at a time. Construction will be sequenced such that all surface construction in a given area will be done at one time. Once completed and opened to pedestrian and vehicular traffic, it is not envisioned that additional work requiring a second relocation of traffic will be necessary. Subsurface construction within a given quadrant may continue, but such construction will not affect surface traffic.

South Station will remain open at all times during construction, with internal detours as necessary to ensure the safe and efficient flow of rapid transit users.

5.13.11.3 Boylston Station

During construction of Boylston Station, interruption to pedestrian and vehicular traffic patterns will be kept to a minimum. Due to the station location, the construction of the concrete diaphragm walls will affect Tremont Street traffic. Construction of the station requires pouring three concrete diaphragm walls from ground level. A portion of the west wall will be located along the Boston Common, the north wall will cross Tremont Street at the Boston Music Company, and the east wall will follow lanes 3 and 4 of Tremont Street. Pouring the west wall will require detouring pedestrian traffic on the Oliver Holmes Mall. Also, pouring the east wall will require temporary closure and decking of lanes 3 and 4 of Tremont Street. Sequential closing of lanes 1, 2, 3, and 4 on Tremont Street will be required while pouring the north wall. This lane closing will be coordinated with the BTD. The construction contract documents will define requirements for traffic detours, street decking, protective barriers, construction vehicle access, signage, and lighting to minimize the effect on traffic and pedestrians, including handicapped accessibility.

5.13.11.4 Other Locations

At other locations, especially where cut-and-cover construction techniques will require open excavations along vehicle and pedestrian corridors, construction plans and specifications will be developed which detail measures to be adopted to mitigate impacts to vehicular and pedestrian traffic. Such measures will include as a minimum:

- *Coordination with other public and private projects;*
- *Requirements for notification of upcoming construction activities which impact abutters and commuters;*
- *Coordination with city agencies affected by construction activities; and*
- *Pre-notification and signage associated with detouring of vehicles and pedestrians around construction sites.*

CHAPTER SIX
Evaluation of Alternatives

CHAPTER 6. EVALUATION OF ALTERNATIVES

6.1 INTRODUCTION

The evaluation of transit alternatives involves the collection, organization, and analysis of an abundance of technical and other information. To assist decisionmakers in assessing the relative pros and cons of each alternative without becoming mired in such information, an evaluation framework has been established for this project. This framework helps identify key differences among alternatives according to three evaluation criteria:

- **Financial Feasibility**: the ability of known funding sources to meet anticipated capital and operating funding requirements of the alternatives
- **Effectiveness**: the degree to which the alternatives assist in the attainment of transportation and other planning goals
- **Cost-effectiveness**: the cost associated with achieving the benefits of each alternative

These criteria are not intended to fully summarize the results of the technical analyses presented in Chapter 4 ("Transportation Impacts") and Chapter 5 ("Environmental Consequences"). Rather, the use of such criteria focuses the evaluation of alternatives on the most pertinent issues affected by the transit project.

In the following sections, each of these evaluation criteria is described in greater detail. Section 6.2 provides an overview of the project's financial feasibility, while Sections 6.3 and 6.4 analyze the effectiveness and cost-effectiveness, respectively, of each alternative. ***Section 6.5 summarizes trade-offs among alternatives, and Section 6.6 describes the two major decisions remaining prior to implementation of the Full Build Transitway.***

6.2 FINANCIAL FEASIBILITY

Financial feasibility refers to the MBTA's ability to meet all of its financial commitments to continue existing transit services, fund expected future maintenance and replacement costs, fund committed growth projects (*i.e.*, the Old Colony Railroad Rehabilitation Project), and have sufficient financial resources remaining to fund the capital and operating and maintenance costs of the South Boston Piers Transit Project.

6.2.1 Methodology

The MBTA's financial feasibility analysis was conducted according to guidance provided by the Federal Transit Administration (FTA). The analysis is documented fully in separate technical reports[1] prepared as part of the South Boston Piers/Fort Point Channel Transit Project. The present discussion is limited to summarizing this more complete analysis.

The purpose of the MBTA's financial analysis is twofold: (1) to assess the financial *condition* of the MBTA in general, and (2) to assess the financial *capacity* of the MBTA to undertake this specific project. Financial condition is evaluated through various financial indicators and analysis of recent financial trends. Financial capacity is measured by examining projected revenue from various sources (this analysis looked ahead

[1] *Report No. 11: Financial Feasibility Methods* (MBTA, September 1991) and *Report No. 20. Financial Feasibility Results* (MBTA, April 1992).

to 2015) and comparing it to the financial obligations of the MBTA. Financial obligations are organized into two categories: first, to provide for the continued operation, maintenance, replacement, and rehabilitation of the existing services and other committed projects; then, to fund the additional capital and operating costs of the South Boston Piers Transit Project. This financial capacity assessment process is illustrated in the decision flow diagram presented in Figure 6-1.

6.2.2 Financial Condition

An analysis of the MBTA's financial indicators for the last twelve years shows the MBTA to be in good financial condition compared to many transit agencies. Costs have been stable, rising in proportion to inflation and amount of service supplied. Ridership has grown at a time when many transit systems have lost riders. The budget approval process has been relatively orderly, and the cost of service (net of fare revenue) has been covered by a combination of local assessments (property taxes) and state assistance.

Over the last decade, the state has assumed an increasing share of the financial support for the MBTA. This is in keeping with state law which limits the growth of local property taxes to 2.5 percent per year, while MBTA costs have been increasing at 6 percent per year. Total state assistance to the MBTA has increased at more than 12 percent per year since 1979 (with growth over the last five years at 16 percent), while federal operating assistance has declined and local (municipal) contributions have grown at less than 2.5 percent. ***In response to questions about the state's financial ability to continue to absorb an increased share of MBTA costs given state budget deficits during the recent economic downturn, the MBTA has committed to a reduction in its budget for fiscal year 1995. A new direction for the MBTA's budget has been charted, one where resources are redirected from administrative programs to direct transportation and safety programs, non-direct transportation support is reduced or eliminated, transportation services are to be improved, new services for the customer are to be added, and commitment to the customers — their safety and comfort — is the focus.***

Four objectives guided this redirection of the MBTA's fiscal year 1995 budget:

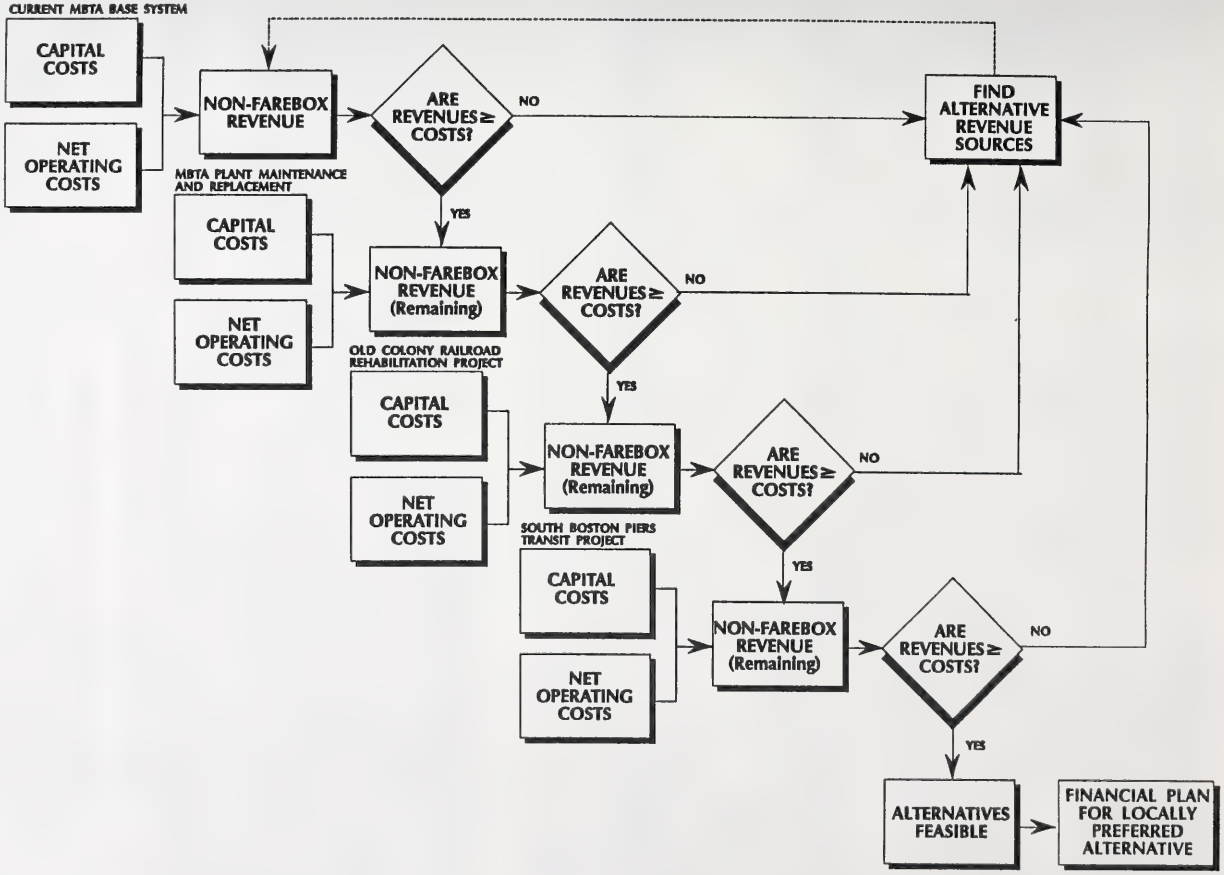
1. ***Reducing operating expenses by $40 million from the FY94 budgeted level;***
2. ***Realigning existing resources directly to transportation services;***
3. ***Increasing service; and***
4. ***Maintaining present fare levels.***

Control of expenses is being emphasized for FY95 to include a focus on strategic thinking and on the outputs of expenditures. By focusing on the outputs or end results of expenditures, the MBTA has been able to identify areas of duplication and redirect resources to priorities with much greater benefit to the customer.

The MBTA has identified $40 million in expense reductions from its FY94 budgeted levels. These reductions result from eliminating non-essential administrative positions, consolidating functions, streamlining and flattening management layers, and eliminating areas of duplication. Four primary reduction initiatives have made this $40 million reduction possible: structural changes, privatization, improved technology, and operations management.

- ***Structural Changes. Fundamental changes in the MBTA's capital program will permit a reduction in the size of the Construction Department. These changes include consolidation of the three Construction Department regional offices into one central office, and reduced reliance on outside design consultants by bringing some functions in-house.***

- ***Privatization. The MBTA has moved forward with the implementation of privatization efforts in areas where services can be improved or provided more economically. FY95 will see the introduction of bus service privatization, and the continued privatization of money counting functions.***



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 6-1
Financial Feasibility Decision Diagram

- ***Improved Technology.*** ***Improved technology will enable the MBTA to improve service while simultaneously reducing costs. The introduction of new token vending machines in some subway stations will provide the customer with the added convenience of purchasing tokens by machine, while reducing the need for collectors. Video cameras will add to the security and safety of the system, and revenue collection efforts will be transformed from a totally manual process to one assisted by automation. These latter technology improvements will support the creation of Station Agents who will be available throughout the station to assist the customer. Another technology initiative — upgrade of the MBTA's telephone customer information system — will improve access to information while reducing reliance on telephone operators.***

- ***Operations Management. As a result of an indepth review of MBTA facilities and the resources to support them, numerous efficiency savings have been identified.***

These budget initiatives will reduce the reliance of the MBTA on state support, limiting growth in this support to 4.8 percent annually between 1993 and 2015. This growth is within long-term projections of indicators for state tax growth.

6.2.3 Financial Capacity

The financial capacity analysis examines projected revenues and costs to determine the ability of the MBTA to pay for current services as well as the South Boston Piers Transit Project. The following is a discussion of the main assumptions used in the projections of MBTA revenues and financial obligations.

6.2.3.1 Sources of Funds and Projected Growth

The MBTA receives revenue from a number of sources:

- **Fares and miscellaneous revenues.** Passenger fares (***$136 million in 1993***) cover approximately ***one-quarter*** of the MBTA's operating costs. This ratio has gone up and down, depending on the timing of fare increases, but has been reasonably stable over the last decade. The financial capacity analysis projected ***the fare recovery ratio for the MBTA's current system to grow gradually from current levels of about 25 percent to 30 percent by 2010 and beyond; individual projects would have somewhat different recovery ratios. Continued growth in ridership, particularly during and after construction of the CA/T Project, will be largely responsible for this increase in the fare recovery ratio.*** Miscellaneous revenues include parking fees, concessions, rentals, and interest on bank accounts. These revenues are also expected to grow ***at an average annual rate of 4.5 percent.***

- **Federal operating assistance.** This funding has remained fairly static at ***$18.2 million*** per year, and accounts for an increasingly small part of total MBTA revenue. This analysis projected no future growth in federal operating assistance.

- **Local assessments.** The law creating the MBTA in 1964 dictated a formula for assessing the net cost of MBTA service to the 78 member municipalities of the MBTA district. Since then, property tax legislation has limited the ability of municipalities to raise property taxes. Consequently, municipal assessments for MBTA costs are held to 2.5 percent growth per year. This is continued into the future. Currently, member municipalities pay ***roughly $129 million*** per year for MBTA service.

- **State contract and additional assistance.** Under Massachusetts law, the state covers up to 90 percent of the debt service (principal and interest) charges incurred by the MBTA to pay for capital expenditures. Contract assistance also covers part of the cost of debt acquired from the MBTA's predecessor agency, as well as the cost of commuter rail service outside the MBTA district. In addition, the state appropriates additional funds each year to pay for that portion of the MBTA's cost of service which is not covered by the revenue sources described above. Money for this additional assistance is appropriated after the fact; that is, after the MBTA budget has been approved by the Advisory Board, and after the money has begun to be spent. The financial analysis assumes average annual increases of ***5.1 percent*** in total state assistance (contract plus additional), with the ***1993*** actual expenses as a base. This is substantially more modest than the average 12 percent increases of the last decade or so, and is consistent with long-term projections of personal income and tax revenue growth. This assumption places a fairly tight limit on total projected MBTA revenue, given the limited growth of other revenue sources.

- **Federal capital grants.** The federal transit program (administered by FTA) provides financial support for local transit projects through two major programs: Section 9, which distributes grants according to a formula based upon population and service factors, and Section 3, which distributes grants through a combination of formula, legislatively-mandated "earmarks," and the discretion of the Secretary of Transportation. Although these and other federal transportation programs have paid for a major portion of the MBTA's capital program since 1965, the level of federal investment in transit has been reduced in real spending terms. As a consequence, federal funds have accounted for a decreasing share of MBTA capital investment. The 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) authorized a significant increase in federal assistance to local transit agencies, and appropriations since ISTEA's enactment have begun to reverse the previous trends. ***Between 1993 and the year 2000, federal capital spending will average $175 million each year. This spending is similar to the receipt of federal funds as shown on Table 6-1. The allocation of these federal funds to specific projects is discussed later in this section.***

- **MBTA Bonds.** The MBTA issues bonds to pay for the local share of all capital projects. The state has contracted to pay up to 90 percent of the debt service on these bonds, and to pay any interest or principal payments due in the event that the MBTA cannot make those payments. Bonds are paid off over 25 to 40 years and currently carry interest rates of approximately ***5.75 (FY94). In FY95, these interest rates are expected to range between 6 and 6.25 percent; between 6.75 and 7.25 percent in FY96; and 8 percent in FY97 and beyond.*** Bonds, which provide revenue to pay for capital projects when they are sold, result in a current expense on the MBTA budget over the next 30 years or so as they are paid back. The MBTA is authorized to incur debt through regular legislation, and it is expected that continued authorization will be provided. The MBTA currently has sufficient bonding authority to cover the expected local share of the most expensive alternative under consideration for the South Boston Piers Transit Project. In this analysis, the amount that can be raised through bonds is limited only by the MBTA's financial capacity to repay them. ***The MBTA has sufficient financial capacity to pay this debt service through fare, state, local, and other revenue sources.***

6.2.3.2 Costs and Financial Obligations

The MBTA's costs and financial obligations that will be included in this analysis are as follows. They are presented in order of funding priority.

- **Costs of operating current services.** ***As noted above in Section 6.2.2, the MBTA is reducing its operating budget for FY95 by $40 million over 1994 levels. In FY96, level funding will result in another small decrease in real spending terms. After 1996, the MBTA's operating budget is anticipated to increase modestly, at a rate of***

TABLE 6-1: SCHEDULE OF FEDERAL FUNDING (thousands of dollars)

Federal Funding Source	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	FY 2005	FY 2010	FY 2015
Section 9 Operating	18,163	18,210	18,210	18,210	18,210	18,210	18,210	18,210	18,210	18,210	18,210
Section 9 Capital	27,608	43,194	43,194	43,194	43,194	43,194	43,194	43,194	43,194	43,194	43,194
Section 3 Fixed Guideway	47,581	52,594	52,594	52,594	52,594	52,594	52,594	52,594	52,594	52,594	52,594
Section 3 New Start	37,963	20,000	42,400	86,200	74,300	52,200	50,800	25,400	53,500	0	0
Congestion Mitigation & Air Quality/Surface Transportation Program	32,243	33,760	28,880	28,800	0	0	0	0	0	0	0
TOTAL	163,558	167,758	185,278	229,078	188,298	166,198	166,798	139,398	167,498	113,998	113,998

about 4.3 percent annually. This modest increase is achievable within the context of the MBTA's commitment to continued privatization of services; healthcare reform initiatives, including copayments of health insurance premimums; technological improvements such as token vending machines; and further organizational realignments that, by shifting existing resources directly to transportation services, afford productivity benefits. Debt service on current debt will decline over time as the principal on outstanding bonds is paid. These costs represent the first priority for MBTA funds.

- ***Accessibility Improvements and Infrastructure Reinvestment Program. Accessibility improvements reflect capital investments in existing facilities consistent with the MBTA's continued commitment to provide improved mobility for persons with disabilities. The access program is primarily dedicated to implementing the MBTA's approved Americans with Disabilities Act (ADA) Key Stations Plan, and includes, among other things, the purchase of 100 new low-floor Green Line cars, the installation of tactile warning strips on station platforms, improved signage and communication, and elevator upgrades. The program also includes the procurement of 92 new RIDE vans in support of the MBTA's ADA Paratransit Plan.***

  The infrastructure reinvestment program represents the need to continue capital investment in the current system, including replacement of vehicles and equipment, rehabilitation of bus garages, stations, track, and structures, and upgrading of power, signal, and communication systems. ***Major projects comprising the infrastructure reinvestment program are the reconstruction of the Boston Engine Terminal; renovation of the Green Line, including track improvements and the procurement of new technology wheels; the purchase of 86 new Red Line cars; the procurement of new fare collection equipment for the subway system; modernization of the Operations Control Center; and implementation of a regular replacement and rehabilitation schedule for the MBTA's bus fleet. Between 1994 and 1998***, the projected costs include costs currently programmed by the MBTA. For subsequent years, the capital needs ***of the accessibility program represent completion of the improvements specified in the Key Stations Plan. Ongoing infrastructure investment costs beyond 1998 represent completion of major projects included in this program and the initiation of new projects. The costs of the accessibility and infrastructure reinvestment program average $230 million per year between 1993 and 2000.*** A portion of these costs is covered by federal grants, with the remainder paid by MBTA bonds; debt service is spread over a 30-year period. The accessibility and infrastructure reinvestment program costs represent the next highest funding priority in this analysis.

- **Old Colony Railroad Rehabilitation Project capital and operating costs.** These capital and operating costs for the Middleborough and Plymouth lines, which have completed preliminary engineering, are included in this analysis as a committed project. In accordance with the ***revised*** Old Colony financing plan, ***80 percent*** of the capital costs are to be covered by federal transit grants, and the remainder by MBTA bonds. The debt service on MBTA bonds, in turn, impacts the current expense budget. ***Section 3 funds will pay for a portion of the project's capital costs, with Congestion Mitigation and Air Quality (CMAQ) and Surface Transportation Program funds bringing the federal share for the project to 80 percent.*** These costs represent a third priority; that is, the Old Colony Project can only be afforded if funds remain after covering the first two priorities.

- **South Boston Piers Transit Project.** The capital and operating costs of the most expensive alternative under consideration as part of the South Boston Piers Transit Project — the Full Build Transitway Alternative — are included in the financial analysis; if the most expensive alternative is found to be financially feasible, then all other alternatives would also be feasible. Costs of the Full Build Alternative are scheduled so that the South

Boston to World Trade Center portion can be constructed between ***1994 and 2000***, with construction of the remaining portion starting in ***2003 with completion scheduled for 2008***. Costs have been inflated to year-of-expenditure dollars using cost inflation factors for operating and capital costs consistent with the rest of the financial analysis. This project follows the current system and committed projects in funding sequence. Capital and operating costs for the Full Build Transitway and all other transit alternatives are shown in Table 6-2.

TABLE 6-2: SOUTH BOSTON PIERS TRANSIT ALTERNATIVES CAPITAL AND OPERATING COSTS* (millions of dollars)

	No Action	*Bus/TSM*	*MOS-1*	*MOS-2*	*Full Build*
Capital Cost (1993 dollars)	*7.8*	*59.7*	*283.9*	*386.4*	*597.4*
Capital Cost (year-of-expenditure dollars)	*8.1*	*66.9*	*326.6*	*438.4*	*741.2*
Annual Operating Costs (1993 dollars)	*4.3*	*20.2*	*25.4*	*25.5*	*26.0*

* ***High growth scenario assumed.***

- **Other growth projects.** The MBTA has programmed other improvements and extensions to the transit system. Such improvements are scheduled to the extent that funds are available to cover the debt service on bonds issued to pay for these projects.

6.2.4 Additional Revenue Sources

6.2.4.1 New Federal Funding Sources

ISTEA earmarks $278 million of Section 3 "New Starts" funds to the South Boston Piers Transit Project. These additional federal funds have been built into the financial analysis for this project; specifically, they are assigned to cover up to 80 percent of the capital outlays for the initial implementation phase of the project, MOS-2, each year over the period 1992 through 1997. ***Due to changes in the alignment and implementation schedule since the project earmark was authorized, however, the $278 million is insufficient to cover the full 80 percent of the MOS-2 project costs; it will be sufficient to cover roughly 64 percent of the initial implementation phase. The MBTA will request additional federal funds to cover this shortfall in the proposed ISTEA technical correction bill in 1994, which is expected to reauthorize earmarked projects. If this funding is not provided, the implementation schedule will be extended commensurate with the state's ability to secure alternative sources of funding.***

Furthermore, although the 1991 Act did not fund projects beyond 1997, the financial analysis assumes that subsequent authorization acts will provide federal funds for the second phase of the project — Full Build — between South Station and Boylston Station at the same 80 percent share. Again, should federal funding beyond the earmarked $278 million not be provided, then the construction schedule of the Full Build Transitway would need to be extended until new sources of funding are identified. At the same time, the MBTA will seek to identify possible project cost savings through value engineering.

The MBTA will also investigate the ability of other federal programs, such as the Section 3 Bus/Bus Facility program, to fund specific projects elements, including vehicle procurement and the maintenance and storage facility.

The FTA has advised the MBTA that the entire $278 million earmarked for this project may not be available over the projected implementation period. The Section 3 share of all projects earmarked in ISTEA exceeds the total amount authorized. Furthermore, the actual appropriations for this program over the first four fiscal years have been less than the authorized levels.

6.2.4.2 New Non-Federal Funding Sources

The MBTA is currently examining the potential for funding a portion of the capital and/or operating costs of the South Boston Piers Transit Project through private sector funding mechanisms, such as joint development or the privatization of certain project elements, or innovative financing techniques, such as certificates of participation. To be consistent with the conservative approach used in this analysis, these new sources were not assumed to be available to fund the project. To the extent that new funding sources are available, they would tend to reduce the share of costs borne by the MBTA and FTA, and would make the project more financially feasible.

6.2.5 Conclusions

The assessment of financial feasibility conducted for this project includes a cash flow analysis which demonstrates that, under the assumptions outlined above, the projected revenues available to the MBTA are sufficient to cover the costs of operating and maintaining the current transit system and committed transit investments (including the Old Colony Project), with sufficient revenue remaining to cover the net operating costs of the Full Build Transitway and the debt service on the local share of capital investment costs. According to this analysis, the projected growth in revenue from fares and state assistance is also sufficient to cover the costs of a continuing service expansion program, with enough slack built into the projected revenue growth to accommodate some uncertainty.

The cash flow analysis was diagrammed previously in Figure 6-1. Table 6-3, drawn from the financial feasibility analysis, shows the annual cash flow requirements of each of the Full Build Transitway funding elements shown in the diagram for each year through 2000, plus 2005, 2010, and 2015. In each case, there are sufficient revenues to cover the projected cash needs.

While the analysis uses generally conservative forecasts, there are uncertainties inherent in the financial analysis and forecasting process. The financial analysis examined these uncertainties and their potential impacts on the transit project through a sensitivity analysis process. Selected tests were used to determine the sensitivity of the conclusions (of financial feasibility) to changes in input variables and assumptions. The following factors were determined to be important sensitivity analysis areas:

- **State assistance**. The projected growth in total state assistance to the MBTA (***5.1 percent*** per year) is well below the rate of the last decade. The MBTA's capital investment program could be affected if state assistance were reduced significantly below this ***5.1 percent*** rate assumed in the financial model.

TABLE 6-3: SOUTH BOSTON PIERS TRANSIT PROJECT FINANCIAL FEASIBILITY ANALYSIS WORKSHEET SUMMARY OF FINANCIAL IMPACT — BASE CASE

$000's	Fiscal Year ----> 1993	1994	1995	1996	1997	1998	1999	2000	2005	2010	2015
SUMMARY OF FINANCIAL IMPACT											
Current Service											
Operating Cost	564,570	564,326	524,297	524,895	547,010	570,088	594,174	619,313	762,553	940,304	1,161,234
Fare Revenue	136,143	136,000	140,000	141,500	147,500	154,000	163,500	173,500	221,000	282,000	348,000
Debt Service	177,428	179,126	181,684	189,883	190,962	189,225	184,429	183,707	173,792	143,633	73,321
Net Cost	605,855	607,452	565,981	573,278	590,472	605,313	615,103	629,520	715,345	801,937	886,555
Accessibility Imps. & Infrastructure Reinvestment											
Operating Cost	0	0	0	0	0	0	0	0	0	0	0
Debt Service	9,431	19,111	31,550	49,939	62,740	73,314	86,838	102,189	187,091	288,525	399,456
Old Colony Restoration Project											
Operating Cost	0	0	0	0	8,054	16,801	17,523	18,277	22,559	27,845	34,369
Fare Revenue	0	0	0	0	5,198	10,884	11,396	11,931	15,012	18,887	23,763
Debt Service	605	841	2,153	4,974	7,051	7,467	7,431	7,435	7,436	7,439	7,444
South Boston Piers Transitway											
Operating Cost	0	0	0	0	0	0	0	28,432	35,094	44,409	54,814
Fare Revenue	0	0	0	0	0	0	0	6,985	8,788	30,657	38,572
Debt Service	330	419	893	2,651	4,304	5,690	6,523	7,216	10,276	11,997	11,728
Other Growth Projects											
Operating Cost	0	5,356	5,586	16,256	16,955	17,684	18,445	19,238	23,745	29,309	36,176
Fare Revenue	0	1,584	1,658	6,971	7,299	7,642	8,001	8,377	10,540	13,261	16,684
Debt Service	1,939	5,332	13,894	26,233	35,021	45,418	53,133	63,187	120,616	193,244	275,056
Total Operating Cost	564,570	569,682	529,883	541,152	572,019	604,574	630,142	685,260	843,952	1,041,867	1,286,594
Total Debt Service	189,733	204,829	230,174	273,680	300,078	321,114	338,354	363,734	499,211	644,838	767,005
Total State Interest Borrowing Costs	6,825	7,050	6,700	7,200	8,135	8,553	8,866	9,700	12,620	15,645	18,983
Total Fare Revenue	136,143	137,584	141,658	148,471	159,997	172,526	182,897	200,793	255,339	344,805	427,018
TOTAL CURRENT EXPENSE (Op. Cost+Debt+State Int.- Fares)	624,985	643,977	625,099	673,560	720,236	761,714	794,465	857,901	1,100,444	1,357,545	1,645,563
Non-Farebox Revenues (Railway Op. & Non-Op. Income)	15,284	14,889	15,906	16,654	17,436	18,256	19,114	20,012	25,178	31,678	39,856
Federal Operating Assistance	18,163	18,210	18,210	18,210	18,210	18,210	18,210	18,210	18,210	18,210	18,210
Total State Assistance	465,332	481,517	458,388	502,787	545,282	582,458	610,781	669,659	887,322	1,115,620	1,370,224
District Assessment	126,206	129,361	132,595	135,910	139,308	142,791	146,360	150,019	169,733	192,037	217,273
TOTAL NON-FAREBOX REVENUES	624,985	643,977	625,099	673,560	720,236	761,714	794,465	857,901	1,100,444	1,357,545	1,645,563
NET REMAINING (NON-FAREBOX REV.- CURRENT EXP.)	0	0	0	0	0	0	0	0	0	0	0

- **Control of operating costs**. Historically, the MBTA has been able to control increases in operating costs within the inflation rate, considering the growth in the amount of service provided (and passengers carried). ***The decrease in FY95 reflects the MBTA's commitment to maximizing existing resources by utilizing them more productively. Additional details on this operating cost reduction is provided above in Section 6.2.2.***

- **Federal funding**. Among the key assumptions in this analysis is the availability of federal funds to cover the $278 million share of the initial implementation phase of the project, as earmarked in the 1991 ISTEA authorization. The impact of reduced federal participation was examined in the financial feasibility analysis. Specifically, the hypothetical case was examined where federal funds would be available for only 50 percent ($184 million) of the costs of the initial over the period 1994 through 2000. The increased local share could be accommodated within the projected implementation schedule without exceeding the ***5.1 percent*** growth rate for state assistance, although this may require the authorization of the state legislature for additional bonding authority. Alternatively, the implementation schedule could be extended consistent with existing bonding authority levels. This reduced federal participation would result in increased costs to the MBTA and the state, and would reduce the funds available for other transit investments in Massachusetts, but would not make the project infeasible, as defined in the financial analysis.

Other changes were examined in the sensitivity analysis (for example, changes in borrowing costs), but none were found to have a significant impact.

6.2.6 Financing Plan

The MBTA proposes to pay the capital costs of the locally preferred alternative selected for the South Boston Piers Transit Project from two sources: (1) FTA Section 3 new start funds and (2) MBTA bonds. All operating costs, as well as the debt service on MBTA bonds, would be part of the MBTA annual budget, and would be paid through established means. These two funding sources are described below.

- **Federal grants.** A congressional earmark of $278 million in Section 3 funds was included in ISTEA. ***As noted above, this earmark will cover approximately 64 percent of the capital costs of the initial implementation phase of the project (MOS-2) from South Station to the World Trade Center. The MBTA will seek an increase in this earmark for a total federal share of 80 percent.***

  As stipulated in ISTEA, FTA is directed to enter a multi-year funding agreement with the MBTA to provide these funds in support of the locally preferred alternative for the South Boston Piers Transit Project. The financial analysis assumes that these funds will be available as required. The year-by-year funding requirements for the transit alternatives are shown in Table 6-4. ***Federal funds for 1993 and 1994 represent actual appropriations.***

  The amount of money that the FTA can actually spend in any given year is limited by the annual appropriation provided through the federal budget process. The availability of funds may affect the schedule for completion of the South Boston Piers Transit Project. The financial feasibility analysis showed that for the most expensive alternative — the Full Build Transitway — the MBTA has sufficient funding flexibility, within the constrained revenue growth assumed, to absorb changes in the project schedule, or to pay a larger share of project costs for any given year.

- **MBTA bonds.** The 1991 Transportation Bond authorization provided general bonding authority, and specific authorization for this project, sufficient to provide the full local share of the portion of the Transitway between South Station and the World Trade Center (MOS-2). With the implementation schedule shown, the MBTA would cover ***$88 million*** of the cost of this first phase through the sale of local bonds. The rates and terms of the bonds required to cover these costs would be determined as bonds are issued shortly before capital costs are incurred. Debt service on the local share of the first segment would total an estimated ***$28 million*** to the MBTA budget.

TABLE 6-4: CAPITAL SPENDING BY YEAR*
(millions of current dollars)

Alternative	Total	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Bus/TSM																
Federal Grants	53.5	4.4	27.7	21.4												
MBTA Bonds	13.4	1.1	7.0	5.3												
Total Capital	66.9	5.5	34.7	26.7												
MOS-1																
Federal Grants	261.3	5.8	12.7	22.3	50.9	63.5	66.6	29.9	9.7							
MBTA Bonds	65.3	1.4	3.2	5.6	12.7	16.6	16.6	7.5	2.4							
Total Capital	326.6	7.2	15.9	27.9	63.6	83.2	83.2	37.4	12.1							
MOS-2																
Federal Grants	350.7	3.5	16.0	42.4	86.2	74.3	52.2	50.8	25.4							
MBTA Bonds	87.7	5.0	(.1)	10.6	21.5	18.6	13.0	12.7	6.3							
Total Capital	438.4	8.5	15.9	53.0	107.7	92.9	65.2	63.5	31.7							
Full Build																
Federal Grants	593.0	4.0	20.0	42.4	81.7	74.3	52.2	50.8	25.4	5.2	5.2	23.9	55.5	53.5	31.1	41.8
MBTA Bonds	148.2	3.5	(4.1)	10.6	26.0	18.6	13.0	12.7	6.3	1.3	1.3	6.0	13.9	13.4	7.8	10.4
Total Capital	741.2	8.5	15.9	53.0	107.7	92.9	65.2	63.5	31.7	6.5	6.5	29.9	69.4	66.9	38.9	52.2

* Assumes high growth scenario.

After completion of the South Station to World Trade Center segment of the Transitway project, the cost of operating the new service (net of added fare revenue) would total an estimated ***$20.5 million per year in year 2000 dollars (inflated from 1993 values at 3.7 percent per year)***. These additional costs would be paid out of existing MBTA revenues, including projected growth in state assistance.

6.3 EFFECTIVENESS

Effectiveness measures the degree to which the alternatives assist in the attainment of transportation and other planning goals formulated for the project area. As described in Chapter 1, the South Boston Piers Transit Project was undertaken as part of a comprehensive effort to achieve a series of broad transportation and regional development goals, as well as specific objectives for improving the quality of transportation services throughout the project area.

Using regional planning goals as a basis, the MBTA has established several goals specific to the South Boston Piers/Fort Point Channel Transit Project. These goals were developed through an extensive inter-agency and community participation process and provide a basis for evaluating the effectiveness of alternative improvements to transportation services and facilities in the South Boston Piers area.

As shown in Table 6-5, project goals are organized into four broad categories: user benefits, economic development, environmental sensitivity, and system performance. These categories represent the most basic requirements of the transit project and help ensure that project goals which fully address such requirements are developed. A greater level of specificity is reflected in the objectives aimed at achieving each goal. Finally, measures of effectiveness (MOEs) relate recognizable and measurable data to each project objective.[2] MOEs provide the means by which the effectiveness of each alternative — ability to achieve project goals and objectives — is quantified. Comparison among alternatives is also enabled by the use of MOEs.

In the sections that follow, each of the four categories of project goals is described, and the ability of the alternatives to support these goals and objectives is assessed. At the conclusion of this section, the alternatives' relative degree of attainment of each goal and objective is summarized in terms of key measures in Table 6-10. In cases where the MOEs for the two MOS Alternatives are similar, results are combined in one section.

6.3.1 User Benefits

The goal associated with the user benefits category is to improve transit service to the Piers area. Three objectives aimed at achieving this goal are as follows:

- Maximize use of public transportation into and out of the Piers area
- Minimize overall travel time to the Piers area
- Maximize convenience of transit service for Piers-bound travelers

Several MOEs were examined for each objective. In nearly every case, the Full Build Alternative performed best, while the MOS Alternatives performed second best, followed by the Bus/TSM Alternative. The evaluation of user benefits MOEs is described below.

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[2] The one exception to this is the MOE used to measure the ability of each alternative to expand in response to future/changing needs in the Piers area. Since this is a subjective MOE, expandability is qualitatively assessed.

TABLE 6-5: PROJECT GOALS, OBJECTIVES, AND MEASURES OF EFFECTIVENESS

Category	Goal	Objective	Measure of Effectiveness
USER BENEFITS	Improve transit service to the Piers area	Maximize use of public transportation into and out of the Piers area	· Daily/peak ridership · Daily/peak transit mode share
		Minimize overall travel time to the Piers area	· Travel time savings · Travel time from selected origins · Travel time from downtown transfer points
		Maximize convenience of transit service for Piers-bound travelers	· Percent of travelers with a maximum of one transfer · Average frequency of service · Average boarding times; number of high level boardings
ECONOMIC DEVELOPMENT	Enable future economic expansion of the Piers area	Maximize Piers area development that can occur without unacceptable consequences	· Square feet of development allowable without degrading traffic LOS below D at Piers area key intersections
		Maximize access to development in the Piers area	· Daily transit mode share to the Piers area

TABLE 6-5: PROJECT GOALS, OBJECTIVES, AND MEASURES OF EFFECTIVENESS (continued)

Category	Goal	Objective	Measure of Effectiveness
ENVIRONMENTAL SENSITIVITY	Mitigate potential traffic problems in the Piers area generated by projected development	Minimize overall traffic volumes into and within the Piers area	· Daily/peak auto trips to the Piers area · 8-hour average vehicular speeds
		Minimize traffic delays at specific locations	· P.M. peak hour LOS at key intersections · P.M. peak hour average stopped delay at key intersections
	Minimize degradation of the natural environment	Minimize air quality degradation in the Piers area	· CO analysis at selected major intersections
		Minimize regional air quality degradation	· Regional VMT
	Preserve cohesion of existing neighborhoods and communities	Minimize the creation of barriers or undesirable visual intrusion	· Number of buses laying over at surface during peak hours · Miles of at-grade catenary structure

TABLE 6-5: PROJECT GOALS, OBJECTIVES, AND MEASURES OF EFFECTIVENESS (continued)

Category	Goal	Objective	Measure of Effectiveness
SYSTEM PERFORMANCE	Provide adaptable and reliable transit service	Provide the opportunity for expansion to meet future/changing needs in the Piers area	· Qualitative assessment of ease of future expansion
		Maximize service performance by providing schedule reliability and safety	· Passenger miles on exclusive weather-protected right-of-way
	Provide efficient and productive transit service	Maximize labor productivity	· Passengers/operator
		Maximize service productivity	· Passengers/revenue mile · Passengers/revenue hour · Average boarding times

Total transit ridership and mode share to the Piers area were examined for both peak hour and daily time periods as measures of transit utilization and, therefore, user benefit. Transit ridership to the Piers area includes all riders who use transit to reach destinations in the Piers area even if they choose to walk from South Station rather than use the Transitway or surface bus services provided by the transit alternatives. Mode shares to the Piers area are derived from this ridership number. While there are additional riders who would use the new transit services to reach other destinations, the MOEs for the user benefits evaluation category address only those riders destined to the Piers area. Total regional systemwide ridership is presented in Chapter 4, Section 4.4.1. See Chapter 4, Section 4.4 for a full discussion of transit ridership and mode share results.

As shown in Table 6-6, projected ridership is highest for the Full Build Alternative with 37,000 and 24,400 daily riders to the Piers area in the 2010 high and lower growth scenarios, respectively. The next highest ridership is projected for the MOS Alternatives with 34,100 daily riders in the high growth scenario and 22,000 in the lower growth scenario. The lowest projected ridership among the "action" alternatives (Bus/TSM, MOS, and Full Build) is for the Bus/TSM Alternative with 29,900 daily riders in the high growth scenario and 19,300 in the lower growth scenario. The No Action Alternative would serve only 21,700 and 16,800 daily Piers area riders on transit in the high growth and lower growth scenarios, respectively. The ranking of alternatives in terms of peak hour ridership is the same as for daily ridership.

TABLE 6-6: TRANSIT RIDERSHIP AND MODE SHARE TO THE PIERS AREA BY ALTERNATIVE

Alternative	Daily Transit Trips to the Piers Area	Daily Transit Mode Share	A.M. Peak Hour Transit Trips to the Piers Area	A.M. Peak Hour Transit Mode Share
Lower Growth Scenario				
No Action	16,800	25%	3,100	25%
Bus/TSM	19,300	28%	5,300	43%
MOS	22,000	33%	6,200	51%
Full Build	24,400	36%	6,600	54%
High Growth Scenario				
No Action	21,700	24%	4,300	23%
Bus/TSM	29,900	33%	9,300	51%
MOS	34,100	38%	10,600	59%
Full Build	37,000	41%	11,200	62%

Since transit mode shares are calculated directly from total Piers area transit ridership estimates, the relative rankings of the alternatives are the same for this measure. Mode shares are further discussed under the Economic Development category (see Section 6.3.2).

Transit Travel Time

The total systemwide travel time savings achieved by each alternative was examined as a measure associated with the objective of minimizing travel time. Projected travel times from each radial corridor and selected residential origin locations were also compared. All travel times were calculated relative to the Bus/TSM Alternative, as required by the cost-effectiveness criteria (see Section 6.4.1).

The Full Build Alternative is projected to achieve the greatest savings in total systemwide travel time in comparison to the Bus/TSM Alternative. In the 2010 high growth scenario, 280,918 minutes of travel time are projected to be saved daily by the Full Build Alternative versus 146,053 minutes daily under the MOS Alternatives. In the lower growth scenario, 184,555 minutes are saved on a daily basis by the Full Build Alternative as compared to 80,590 minutes by the MOS Alternatives. These travel time savings are summarized in Table 6-7.

TABLE 6-7: TRAVEL TIME SAVINGS

Alternative	Travel Time Savings* (minutes)
Lower Growth Scenario	
MOS	80,590
Full Build	184,555
High Growth Scenario	
MOS	146,053
Full Build	280,918

* As compared to the Bus/TSM Alternative.

The differences in weighted and unweighted travel time to selected locations in the Piers area were also examined as a measure of travel time improvement. Projected travel times were measured from the six downtown transfer points that serve all of the major radial transit services and were compared to the Bus/TSM Alternative. Travel times from the transfer points serving the Blue Line, Orange Line North, and North Station/Haymarket express bus and commuter rail lines would not differ among alternatives. Travel times from the points serving the Green Line and Orange Line South would be improved by as much as 7 to 15 minutes under the Full Build Alternative; however, no travel time improvements from the Blue, Green, and Orange Lines are projected under the MOS Alternatives. Travel times from transfer points serving the Red Line and South Station Transportation Center would be improved by 4 to 6 minutes under both the MOS and Full Build Alternatives. Weighted travel times, in which out-of-vehicle time is attributed greater importance, would be affected in a similar manner. As compared to the Bus/TSM Alternative, the Full Build Alternative would provide travel time improvements from the most transfer points; these points serve corridors representing about 77 percent of the Piers area transit riders. The MOS Alternatives would offer improvements from corridors representing only about 49 percent of Piers area transit riders. Travel times from eighteen other origins in the metropolitan Boston and suburban region were found to achieve savings in similar proportion among the alternatives.

Convenience of Transit Travel

The convenience of transit for travel to the Piers area was examined using several measures: the percentage of Piers area travelers needing no more than one transfer, average frequency of service, and transit vehicle boarding times combined with the number of high level boardings. These measures are summarized in Table 6-8.

TABLE 6-8: CONVENIENCE OF TRANSIT TRAVEL

Alternative	Percentage of Riders Needing No More Than One Transfer	Average Frequency of Service (buses per hour)	Transit Vehicle Boarding Times (seconds per passenger)	Daily High Level Boardings
Lower Growth Scenario				
No Action	86	10	3.5	0
Bus/TSM	88	11	3.5	0
MOS	79	20	1.5	MOS-1: 11,400 MOS-2: 19,500
Full Build	82	34	1.5	39,300
High Growth Scenario				
No Action	87	10	3.5	0
Bus/TSM	88	11	3.5	0
MOS	81	30	1.5	MOS-1: 16,600 MOS-2: 27,500
Full Build	83	53	1.5	53,600

In the evaluation of Piers area transit alternatives, the percentage of transit riders requiring at most one transfer is a measure that produces ambiguous results when taken alone. While the number of transfers required is usually an indicator of the directness and quality of transit service, in this case many riders may choose to transfer to a fast, frequent service to avoid even a moderately short walk. Conversely, riders may avoid a transfer to a low quality service by walking a relatively long distance from a radial transit line downtown to the Piers area (for example, from South Station across the Fort Point Channel). Thus, the number of transfers made can only be interpreted as a measure of convenience if the percentage of transit users walking across the Fort Point Channel from downtown to the Piers area is also considered.

While the percentage of transit riders needing no more than one transfer is projected to be highest for the Bus/TSM Alternative (88 percent in both growth scenarios) this alternative would also result in a high percentage of Piers area riders walking across the channel (36 and 40 percent in the high and lower growth scenarios, respectively). The No Action Alternative would have nearly as many riders needing no more

than one transfer (86 percent in the lower growth scenario and ***87 percent*** in the high growth scenario) but would result in the highest percentage of Piers area riders walking across the channel (54 percent). With so many more riders walking across the channel and a higher percentage of multiple transfer trips, the No Action Alternative would appear to be less convenient than the Bus/TSM Alternative.

While the Full Build and MOS Alternatives rank slightly below the Bus/TSM and No Action Alternative in the number of riders needing no more than one transfer, these alternatives can actually be viewed as more convenient since they would result in a far smaller percentage of riders walking across the channel. Under the Full Build Alternative, 82 to 83 percent of riders would make at most one transfer (lower growth versus high growth), while only 7 percent would walk across the channel. Under the MOS Alternatives, 79 to 81 percent of riders would make at most one transfer, while 14 to 18 percent would walk across the channel. Thus, taking into account the inconvenience of walking across the channel, the Full Build Alternative can be considered most convenient, followed by the MOS, Bus/TSM, and No Action Alternatives. The relationship between transfers and walking is shown in Figures 6-2 and 6-3 for the lower and high growth scenarios, respectively.

Average frequency of service reflects the convenience of shorter waiting time. Measured for all riders of Piers area services, excluding express buses, the average frequency would be greatest for the Full Build Alternative. The average frequency of service encountered would be 53 vehicles per hour in the high growth scenario and 34 vehicles per hour in the lower growth scenario. The MOS Alternatives would rank second with 20 to 30 vehicles per hour (lower versus high growth scenario), while the least frequent service would be provided by the Bus/TSM and No Action Alternatives with 11 and 10 buses per hour, respectively, in both growth scenarios. The higher frequencies on the Transitway services in the MOS and Full Build Alternatives would clearly result in shorter wait times and thus greater convenience for riders destined to the Piers area.

Vehicle boarding times are indicative of the passenger convenience and safety associated with the type of service provided. The conventional curbside loading associated with the No Action and Bus/TSM Alternatives would require an average boarding time of 3.5 seconds per passenger assuming a pay-as-you-enter regimen.[3] Operator-assisted boarding of disabled and special needs passengers would serve to further increase this average.

The underground Transitway stations would offer high level (vehicle floor-height) platforms with an average boarding time of approximately 1.5 seconds per passenger. The use of conventional turnstile equipped station platforms would eliminate the need for on-board vehicle fare collection within the Transitway, thereby permitting multiple door boarding of the vehicles. Disabled passengers would not require special handling by the vehicle operator but would enter/exit the vehicle with the passenger stream. Although some supporting Transitway services in the MOS and Full Build Alternatives would continue to operate on-street, a significant number of expedited high-platform boardings would be provided in the Full Build, MOS-2, and MOS-1 Alternatives (53,600; 27,500; and 16,600 daily in the 2010 high growth scenario, respectively, and 39,300; 19,500; and 11,400 in the lower growth scenario) as compared to none in the Bus/TSM and No Action Alternatives.

6.3.2 Economic Development

The goal of this category is to enable future economic expansion of the South Boston Piers area. Two objectives relevant to this goal are as follows:

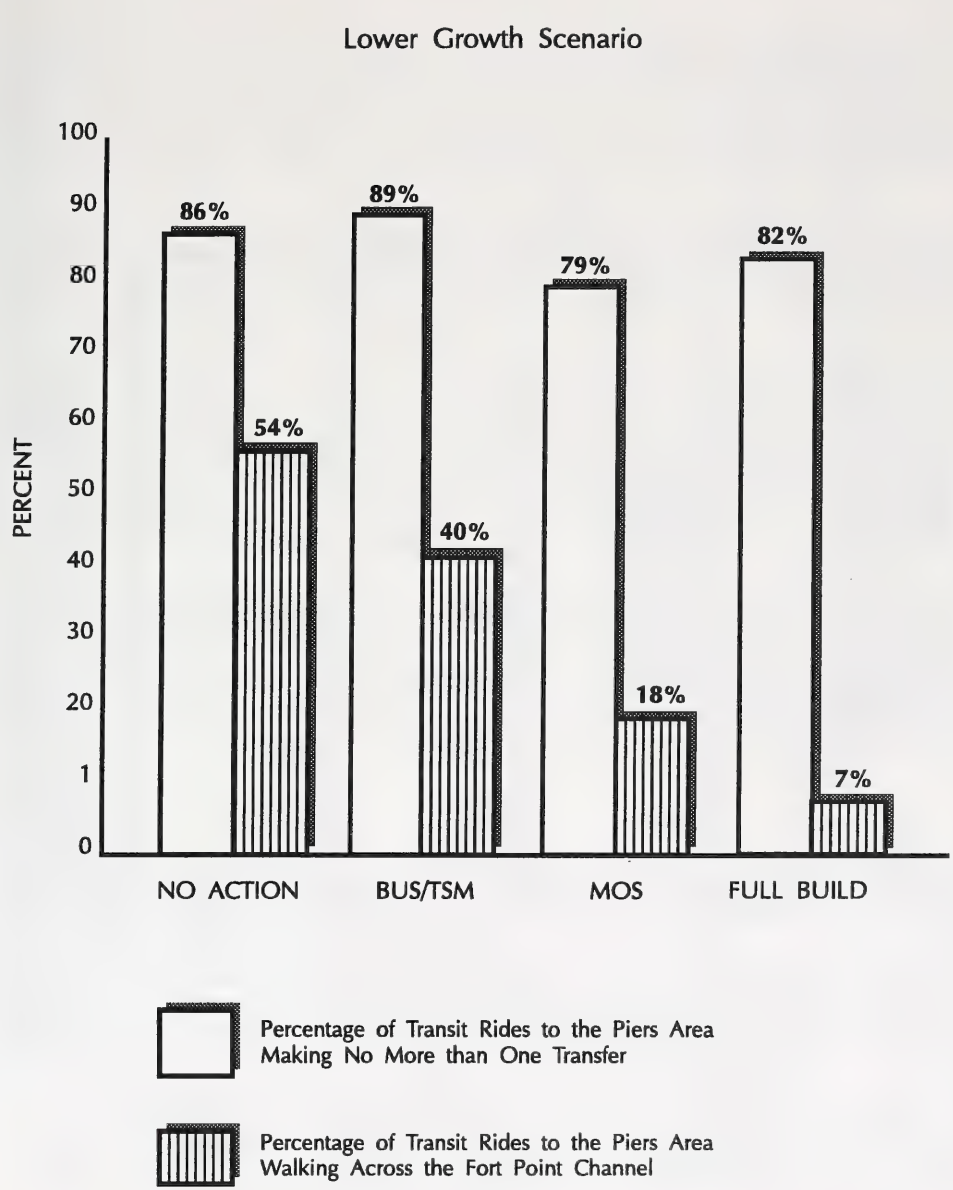
- Maximize Piers area development that can occur without unacceptable traffic consequences
- Maximize access to development in the Piers area

[3] Transportation Research Board. *Highway Capacity Manual*, 1985. Table 12-9.

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

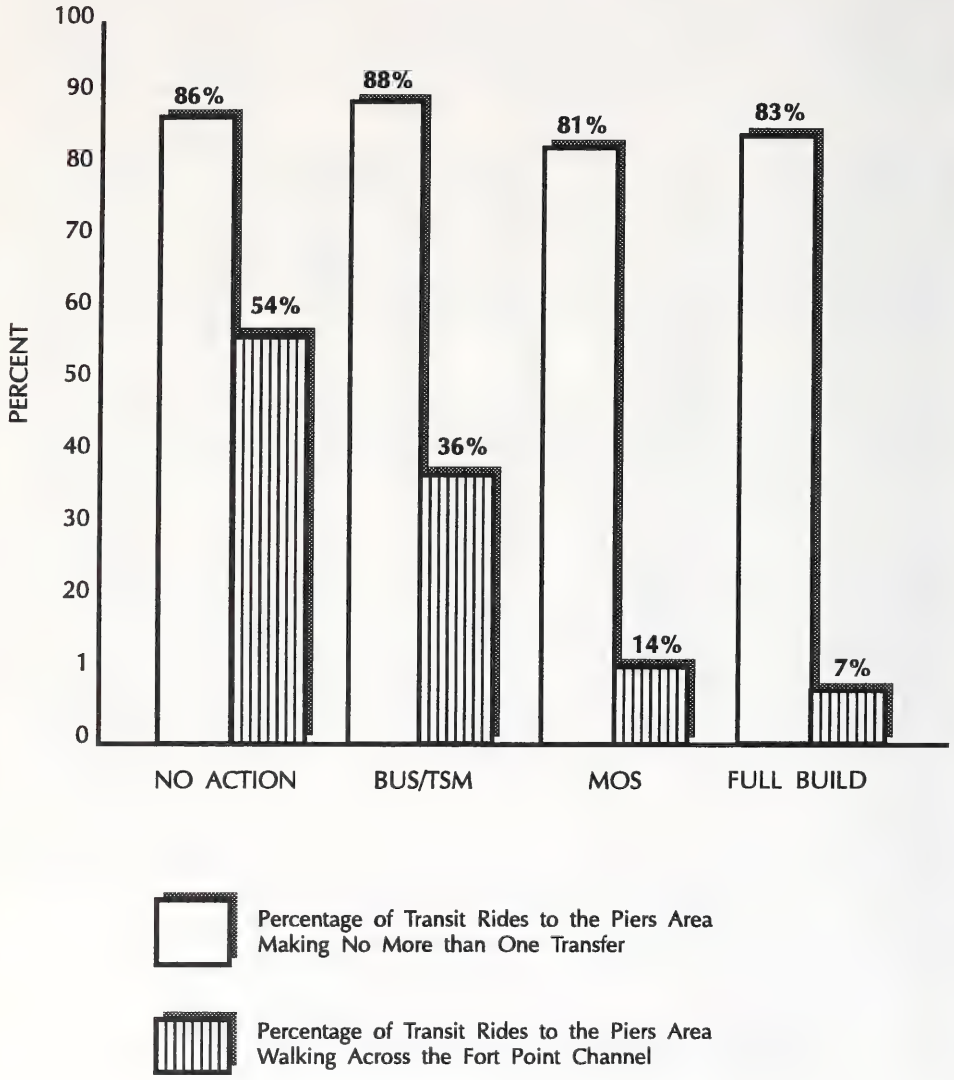
Fig. 6-2
Relationship Between Transfers and Walking by Alternative



MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

South Boston Piers/ Fort Point Channel Transit Project

Fig. 6-3
Relationship Between Transfers and Walking by Alternative



MOEs used to assess each alternative's attainment of these two objectives are square feet of development allowable without degrading traffic level of service (LOS) below D at Piers area key intersections, and daily transit mode share to the Piers area. These MOEs are presented below.

Supportable Development

A methodology was developed to estimate the amount of development that could be supported in the Piers area under each transit alternative. This methodology, which is described in detail in Chapter 5, Section 5.2.1.1, involved analyzing the relationship between Piers area traffic conditions and land use assumptions. It was concluded that, assuming acceptable traffic conditions defined as LOS D at all key Piers area intersections, only the Full Build Alternative supports the full 2010 buildout development plans for the Piers area (*i.e.*, the high growth scenario). Moreover, future conversion of the Transitway to light rail operation could support an additional 7.1 million square feet of development.

As shown in Figure 6-4, the Full Build Alternative could support not only the 21.7 million square feet of development forecasted in local plans, but an additional 7.1 million square feet as well, for a total potential supportable buildout of 28.8 million square feet. The MOS Alternatives, which result in some unacceptable traffic conditions, support 20.8 million square feet; if ultimately converted to light rail operation, these alternatives could support 27.9 million square feet.

The Bus/TSM and No Action Alternatives, however, could require the elimination or redistribution of a significant amount of development throughout the Piers area. This is due to unacceptable traffic conditions in both alternatives and the inability to expand capacity through a future conversion to light rail. The Bus/TSM Alternative is estimated to support only 18.7 million square feet of development, 14 percent below the planned development projection and 35 percent below the level supportable by light rail operation. The No Action Alternative supports even less development; only 13.5 million square feet of development could be supported in the Piers area under the No Action Alternative. This represents a loss or relocation of 38 percent of the 2010 Piers area development projection and more than half of future development potential.

As noted in the analysis presented in Chapter 5, this lost or relocated development opportunity should be viewed as a worst case scenario. For example, it is reasonable to expect that other factors, such as peak spreading (the shifting of some trips beyond the peak hour), greater use of carpools, and a different mix of development that stresses off-peak trip generation, such as retail and industrial uses, could combine to limit the actual ceiling on development required to achieve acceptable traffic conditions. ***However, near-term development projects in the Piers area, such as the Federal Courthouse and the World Trade Center expansion, will require the transit service provided by the Transitway to support their operations.***

Daily Transit Mode Share

At 24 percent in the high growth scenario and 25 percent in the lower growth scenario, the daily transit mode share of the No Action Alternative in 2010 is the lowest of any alternative considered. While this alternative could potentially attract a somewhat higher ridership, the No Action Alternative is constrained by the capacity of the MBTA's existing bus maintenance and storage facilities.

At 33 percent in the high growth scenario and 28 percent in the lower growth scenario, the Bus/TSM Alternative is projected to achieve the lowest daily transit mode share in 2010 of any of the action alternatives. The MOS Alternatives achieve a further incremental increase in transit mode share to 38 percent (high growth) or 33 percent (lower growth).

The transit service provided by the Full Build Alternative earns it the highest daily transit mode share — 41 percent in the high growth scenario and 36 percent in the lower growth scenario — of any alternative considered. In the high growth scenario, the Full Build Alternative's 2010 daily transit mode share is only 2 percentage points below the projected share to downtown Boston, reflecting a level of transit service to the Piers area that would be as attractive as downtown services.

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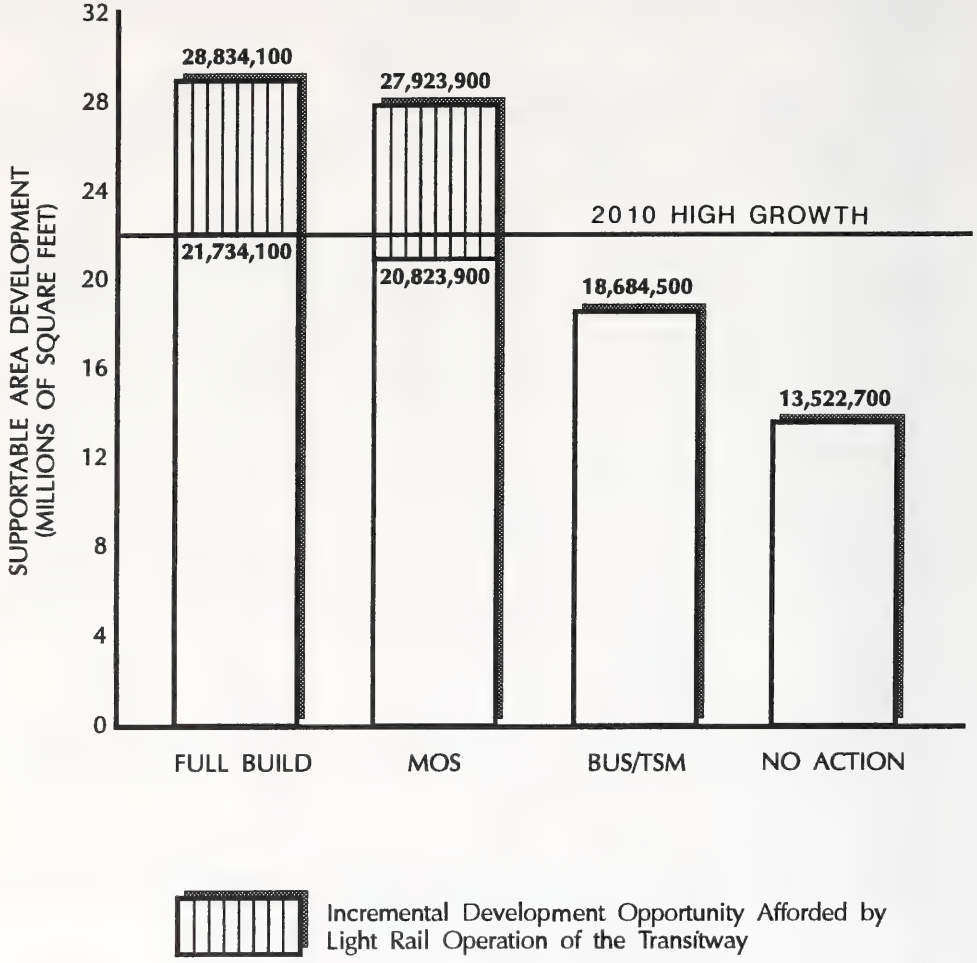
Fig. 6–4
Supportable Piers Area Development



6.3.3 Environmental Sensitivity

Project goals for this category are to: (1) mitigate potential traffic problems in the Piers area generated by projected development; (2) minimize degradation of the natural environment; and (3) preserve cohesion of existing neighborhoods and communities. Associated objectives are as follows:

- Minimize overall traffic volumes into and within the Piers area
- Minimize traffic delays at specific locations
- Minimize air quality degradation in the Piers area
- Minimize regional air quality degradation
- Minimize the creation of barriers or undesirable visual intrusion

MOEs used to assess the ability of each alternative to attain these goals and objectives focus on traffic conditions and their effect on access and the social and natural environment. In the sections below, MOEs are quantified for each alternative.

In progressing from the No Action to the Full Build, the alternatives demonstrate an improvement in on-street traffic conditions with the attendant improvement in congestion and air quality. The MOS and Full Build Alternatives, by virtue of providing an underground transit right-of-way, also offer significant reductions in on-street transit encumbrances such as bus layovers in commercial and residential areas and catenary structures.

Auto Trips to the Piers Area

The increase in the use of transit for trips to the Piers area that results from each of the action alternatives would result in a reduction in the number of auto trips. In comparison to the No Action Alternative for the year 2010, the Bus/TSM Alternative represents a daily decrease in auto trips of 5,900 and 1,800 in the high and lower growth scenarios, respectively. The MOS Alternatives would divert 3,800 trips (lower growth) to 8,900 trips (high growth), while the Full Build Alternative would result in a reduction of 5,500 to 11,000 auto trips in the lower and high growth scenarios, respectively.

Average Vehicular Speed

Average 8-hour vehicular speeds were calculated on the entire roadway network as required for air quality analyses. Major thoroughfares experienced significant declines in speeds in moving from the Full Build Alternative to the No Action Alternative. New Northern Avenue between East Service Road and B Street exhibited a 25 percent drop in operating speeds between the Full Build and No Action Alternatives (28 mph to 21 mph) in the year 2010 high growth scenario. Comparable values for both the MOS and the Bus/TSM Alternatives are 28 mph. The average speed on New Northern Avenue at West Service Road deteriorates from 11 mph in the Full Build Alternative to 3 mph in the No Action Alternative. D Street southbound approaching New Congress Street has a 10 mph average speed in the Full Build Alternative which drops to 1 mph in the No Action Alternative, a 90 percent decrease. It should be noted that these MOS, Bus/TSM, and No Action traffic data do not reflect the scaled-down development scenarios discussed previously. These traffic results, however, reinforce the need to limit such development in order to provide acceptable traffic conditions.

P.M. Peak Hour Level of Service (LOS)

Analyses were conducted for the p.m. peak hour at eight intersections in downtown Boston and at seventeen South Boston intersections. Particularly in the high growth scenario, the analyses exhibit a strong trend of improving traffic conditions in progressing from the No Action Alternative to the Full Build

Alternative. For example, in the 2010 high growth scenario, six signalized intersections would operate at LOS E or F in the No Action Alternative. The Bus/TSM Alternative would result in two signalized intersections performing at LOS E or F, while the MOS Alternatives would still produce a single LOS E intersection. Only the Full Build Alternative would result in all signalized intersections operating at LOS D or better.

P.M. Peak Hour Average Stopped Delay

The average stopped delay at the analyzed intersections represents a more quantitative measure associated with the LOS value. Again, the trend in lesser delay from the No Action to Full Build Alternative is more pronounced in the high growth scenario which experiences more traffic congestion than the lower growth scenario. In 2010 (high growth), for all signalized intersections which were analyzed, the average delay is 16 seconds for the Full Build Alternative, 17 seconds for the MOS Alternatives, 19 seconds for the Bus/TSM Alternative, and 29 seconds for the No Action Alternative. The maximum average delay is 40 seconds for the Full Build Alternative, with the comparable values for the MOS, Bus/TSM, and No Action Alternatives of 44 seconds, 66 seconds, and 89 seconds, respectively. The Full Build Alternative represents a nearly 55 percent reduction in the maximum average delay over the No Action Alternative. The differences are less pronounced in the lower growth scenario due to the less congested traffic conditions.

CO Analysis

A detailed analysis of carbon monoxide (CO) concentrations was performed at five key intersections as identified by the U.S. Environmental Protection Agency (EPA). The results of these analyses reflect the decreasing levels of congestion identified in the LOS analysis. This intersection (microscale) analysis is representative of localized air quality concerns. Regional pollutant burdens were evaluated on the basis of vehicle miles of travel.

Vehicle Miles Traveled (VMT)

The reduction in ***all classification of vehicle*** trips would produce a corresponding reduction in VMT. Reductions in 2010 as measured against the No Action Alternative would be ***311,428*** daily vehicle miles for the Full Build Alternative in the high growth scenario and ***169,786*** in the lower growth scenario. The corresponding values for the MOS and Bus/TSM Alternatives for the high/lower growth scenarios are ***280,036/144,786*** and ***227,308/111,689***, respectively. To put these distinctions in context, the VMT reduction associated with the Full Build Alternative in the high growth scenario, as compared to the Bus/TSM Alternative, represents approximately ***15 percent*** of the VMT for trips destined to the Piers area and ***0.09 percent*** of total regional VMT. Thus, the impact of the alternatives is focused on trips to or from the Piers area. These data are also reflected in the corresponding reduction in regional pollutant emissions developed in the regional (mesoscale) air quality analysis.

Bus Layovers

Terminal points for bus routes tend to accumulate idling buses for extended periods of time in order to provide for layover of various routes. The layover time reflects the "pad" or operational recovery time incorporated in the service timetables. As shown in Table 6-9, under both scenarios, the Bus/TSM Alternative would result in ***82*** peak buses per hour using layover sites located in residential and commercial areas. This intensity would encompass the entire five hours associated with peak periods during the course of the day. This number increases to ***84*** (lower growth) to ***96*** (high growth) in the MOS Alternatives. For the Full Build Alternative, the absence of shuttle bus services to the Back Bay and New England Medical Center areas results in a total of ***52*** to ***74*** peak buses (lower growth versus high growth) laying over in areas that are neither industrial nor MBTA-owned property. This represents ***up to 50 percent*** percent decrease in such layover activity in comparison to the Bus/TSM Alternative.

TABLE 6-9: BUS LAYOVERS - NUMBER OF BUSES PER HOUR DURING PEAK PERIODS

Layover Site	No Action	Bus/TSM		MOS		Full Build	
		High Growth	Lower Growth	High Growth	Lower Growth	High Growth	Lower Growth
Sleeper Street	0	16	16	16	16	0	0
Boston Marine Industrial Park*							
· Harbor Street	12	34	32	24	24	8	8
· Drydock Avenue	0	0	0	37	23	38	23
New England Medical Center	0	16	16	16	16	0	0
Copley Square (Dartmouth Street)	0	16	16	16	16	0	0
Congress and B Streets	0	20	20	25	18	17	12
Summer Street and Atlantic Avenue	0	12	12	4	4	4	4
North Station Terminal**	6	29	28	33	26	25	20
Summer and Fargo Streets	0	2	2	19	14	40	25
L and East First Streets*	***0***	***0***	***0***	***0***	***0***	***13***	***11***
City Point**	12	6	6	7	5	0	0
TOTAL ALL LOCATIONS	30	151	148	197	162	145	103
TOTAL ALL LOCATIONS EXCEPT BMIP AND MBTA PROPERTY	***0***	***82***	***82***	***96***	***84***	***74***	***52***

* The BMIP terminus is located within an industrial area and thus will not have an impact on residential areas.

** These three sites are MBTA-owned property and would not have an impact on residential areas.

Miles of At-Grade Catenary Structure

Catenary structure (overhead trolley wire, masts, brackets, etc.) would be a visible impact of the Transitway trackless trolley service. Only the MOS and Full Build Alternatives would be affected, and impacts would be limited to the Boston Marine Industrial Park and Summer/D Streets routes under both alternatives, and in a portion of residential South Boston in the Full Build Alternative. For MOS-1, with a tunnel portal at Fan Pier, approximately ***3.0 route mile (includes catenary on both sides of some two-way streets)*** would utilize at-grade catenary. Under MOS-2 and the Full Build Alternative, with a portal at D Street, ***2.2 and 4.2 route miles, respectively,*** would require at-grade catenary. ***Although the Full Build requires the most at-grade catenary, it should be noted that this catenary is limited to the industrial eastern portion of the Piers area, and, beginning in the year 2008, to a limited residential South Boston route; neither the MOS-2 nor Full Build Alternatives would involve the installation of catenary on the two planned boulevards in the Piers area — New Northern Avenue and New Congress Street.*** Catenary structure requirements would be the same in both growth scenarios.

6.3.4 System Performance

The two goals in the system performance category — (1) provide adaptable and reliable transit service and (2) provide efficient and productive transit service — have four associated objectives:

- Provide the opportunity for expansion to meet future/changing needs in the Piers area
- Maximize service performance by providing schedule reliability and safety
- Maximize labor productivity
- Maximize service productivity

MOEs for this category are discussed below.

Opportunity for Future System Expansion

The nature of this measure requires that it be discussed in a more qualitative way than other performance measures. System expansion can refer to the possibility of enlarging the service plan and project service area associated with the project alternatives, and it can also be applied to physical expansion of the fixed facilities that are provided under each alternative. The No Action Alternative, by virtue of having no new capital facilities, can be considered only in terms of service expansion. However, since this alternative is already severely constrained by its inability to provide the requisite bus maintenance and storage facilities, any future service expansion would have to occur by sacrificing other existing MBTA services.

The Bus/TSM Alternative offers the potential for expansion of on-street bus operations in the project area. However, traffic analysis suggests that expansion of such services would incur negative operational impacts in terms of additional traffic delays and saturation of designated bus loading and layover sites. Both the Bus/TSM and No Action Alternatives could forever eschew the ability to provide a designated grade-separated transit right-of-way.

The various Transitway Alternatives would provide much better opportunities for future system expansion. MOS-1 would at least provide a minimal grade-separated right-of-way by virtue of the tunnel segment between South Station and Fan Pier. Physical expansion in the Piers area would require disruptive tunnel construction under the New Northern Avenue, Seaport Access Road Ramp F, New Congress Street, and the Massport Replacement Parking Garage at World Trade Center. Such construction, if feasible and acceptable to the affected properties, could prove to be economically prohibitive. Lack of an underground right-of-way to Boylston Station could similarly result in construction constraints based on new building development in the contemplated right-of-way. Service expansion for MOS-1, absent physical expansion

of the tunnel, would require additional bus movements at the somewhat unsatisfactory portal location alongside New Northern Avenue at Fan Pier.

Both the MOS-2 and the Full Build Alternatives would better provide for future expansion of services in the Piers area by providing a portal location at D Street, easily accessed from the Third Harbor Tunnel and residential South Boston. Transitway tunnel capacity could be enhanced by upgrading of vehicle control/signalization systems to permit extensive vehicle platooning operations. In the downtown area, MOS-2 would incur the same extension concerns as would MOS-1. All Transitway Alternatives would, by virtue of the tunnel design standards, have the potential to accommodate substantial capacity/service expansion if converted to light rail operation. The Full Build Alternative would seem best suited to such a conversion since a connection to the Central Subway at Boylston Station (albeit with significant track and tunnel modifications) would permit numerous through-routing service plans which would not be possible with an isolated light rail line.

Reliability and Safety

The reliability of a service is dependent on several factors. The factor that would vary the most across the alternatives would be the extent to which service is provided in an exclusive, weather-protected right-of-way, free from interfering traffic and unfavorable weather conditions. This measure can also be an indicator of safety. Potential reliability was measured by the number of passenger-miles occurring in exclusive, weather-protected right-of-way. The Full Build Alternative would produce 71,900 such passenger-miles in 2010 under both growth scenarios, the most of any alternative considered. The MOS-2 Alternative is projected to produce the next highest number of 26,000 passenger-miles, while the MOS-1 Alternative would be third with 14,800 passenger-miles; again, there is no difference in this measure between the high and lower growth scenarios. The Bus/TSM Alternative would provide some service on short decked portions of the Seaport Access Road and some service on an exclusive bus lane (three blocks) in the Piers area under the high growth scenario only; however, these limited facilities would not be comparable to an exclusive transit-operated tunnel right-of-way. The No Action Alternative would not include any service on exclusive, weather-protected right-of-way.

Labor Productivity

Labor productivity is measured as daily passengers per operator. It is projected to be highest for the Full Build Alternative with 548 daily passengers per operator in 2010 on all services combined. This includes a productivity of 879 daily passengers per operator on Transitway services and lower productivities on surface bus services. The productivity of the MOS Alternatives is projected to be second highest at 447 daily passengers per operator, including 799 passengers per operator on Transitway services. The Bus/TSM Alternative is projected to have the lowest labor productivity of the action alternatives with 417 daily passengers per operator, all on surface buses.

Service Productivity

Service productivity was examined using two measures: a.m. peak hour passengers per vehicle-hour and a.m. peak hour passengers per vehicle-mile. Under the high growth scenario, service productivity is projected to be highest for the Full Build Alternative according to both measures, with 158 passengers per vehicle-hour and 20.2 passengers per vehicle-mile in 2010 on all services combined (excluding express bus services). This includes a productivity of 244 passengers per vehicle-hour and 25.8 passengers per vehicle-mile on Transitway services; lower productivities would occur on the Full Build Alternatives's surface bus services. The productivity of the Bus/TSM Alternative is projected to be second with 107 passengers per vehicle-hour and 15.7 passengers per vehicle-mile. Services provided in the MOS Alternatives are projected to have service productivities of 101 passengers per vehicle-hour and 15.0 passengers per vehicle-mile, only slightly below the Bus/TSM Alternative; routes that use the Transitway achieve productivities of 208 passengers per vehicle-hour and 30.0 passengers per vehicle-mile. The No Action Alternative is projected to have service productivities of only 89 passengers per vehicle-hour, the lowest of all alternatives, and 15.3 passengers per vehicle-mile, similar to the Bus/TSM and MOS Alternatives.

TABLE 6-10: SUMMARY OF MEASURES OF EFFECTIVENESS - 2010

Alternative	Peak Hour Ridership (to Piers Area)	Peak Hour Transit Mode Share (to Piers Area)	Travel Time Savings (daily minutes)*	Reduction in Piers Area Development Plans (millions of square feet)**	P.M. Peak Hour Average Delay (seconds)	Daily Regional VMT Reductions (miles)***	Passenger Miles on Exclusive Right-of-Way
Lower Growth Scenario							
No Action	3,100	25 percent	---	0.0	13	---	0
Bus/TSM	5,300	43 percent	---	0.0	12	***111,689***	0
MOS	6,200	51 percent	80,590	0.0	12	***144,786***	MOS-1: 8,680 MOS-2: 15,300
Full Build	6,600	54 percent	184,555	0.0	11	***169,786***	42,400
High Growth Scenario							
No Action	4,300	23 percent	---	8.2 (-38%)	31	---	0
Bus/TSM	9,300	51 percent	---	3.1 (-14%)	21	***227,308***	0
MOS	10,600	59 percent	146,053	0.9 (-4%)	17	***280,036***	MOS-1: 14,800 MOS-2: 26,200
Full Build	11,200	62 percent	280,918	0.0	15	***311,428***	71,900

* Calculated based on the Bus/TSM Alternative.

** Percent shown in parentheses represents the development reduction relative to the Full Build Alternative; does not reflect additional buildout beyond 2010 high growth development plans supportable by future conversion to light rail.

*** Calculated based on the No Action Alternative.

Under the lower growth scenario, the Full Build Alternative is again the most productive using both measures, with 143 passengers per vehicle-hour and 19.5 passengers per vehicle-mile. However, the MOS Alternatives are more productive than the Bus/TSM Alternative in this scenario. Eighty-six passengers per vehicle-hour are served by the MOS Alternatives as compared to 74 served by the Bus/TSM Alternative.

In terms of passengers per vehicle-mile, the MOS Alternatives serve 12.6, while the Bus/TSM Alternative serves only 10.8. The No Action Alternative has the lowest productivity of all alternatives in the lower growth scenario according to both measures: 59 passengers per vehicle-hour and 10.1 passengers per vehicle-mile.

6.4 COST-EFFECTIVENESS

6.4.1 Cost-Effectiveness Methodology

The cost-effectiveness of each alternative was measured using two indices: the new trip index and the user benefit index. For both indices, the measurement of cost-effectiveness incorporates all measures of impact that can be combined in a non-duplicative manner; that is, all costs associated with the projects and all the benefits that will be derived. For the sake of simplicity, the set of impacts has been limited to:

- Capital cost of the improvements, annualized over the lifetime of the project
- Annual operating costs
- Tangible transportation benefits to new and existing riders

Since benefits such as improvements to air quality are proportional to transportation benefits, the cost-effectiveness indices implicitly reflect the environmental and social impacts of each alternative. Furthermore, in cases where a negative impact is mitigated as part of the alternative, the cost of the mitigation measure is included in the alternative's capital costs. However, to enable a more rigorous analysis of changes to the social and physical environment caused by each alternative, such impacts are also analyzed separately from the cost effectiveness calculation. This allows decision makers to assess each environmental impact in greater detail and thereby make informed trade-offs among alternatives.

The tangible transportation benefits are measured explicitly and converted to a single common unit of measurement as appropriate. This is accomplished somewhat differently in the new trip and user benefit cost-effectiveness indices. In the new trip index, the time savings to existing riders (transit patrons who would be carried in the selected analysis year under the Bus/TSM Alternative) is treated as a dollar savings that can be subtracted from the overall cost of the alternative. The benefit to new riders is represented as the net cost to serve each new rider. This latter benefit reflects the relative ability of each alternative to attract new riders.

The user benefit index does not convert time savings to cost but measures the number of hours of time saved. This requires estimation of the time savings accruing to both new and existing riders. The microeconomic theory of consumer surplus, in which the time savings accruing to each rider as a result of the transportation improvement is calculated, is used to estimate the benefits to new and existing riders.

6.4.1.1 New Trip Index

This index is a measure of the net cost per new passenger attracted by the transit improvement. It explicitly considers the annualized operating and capital costs of the alternative relative to the Bus/TSM Alternative, and incorporates a negative cost, or benefit, to represent travel time savings to current riders. This net cost measure is then divided by the net additional riders, again relative to the Bus/TSM Alternative, to derive a measure expressed in dollars per passenger. The Bus/TSM Alternative serves as the point of

comparison since it represents a low-cost, non-heavy construction oriented approach to the transportation problem. This comparison is expressed by the following formula:

$$\text{Cost Per New Rider} = \frac{\Delta\$CAP + \Delta\$OP - \Delta TT\ Savings}{\Delta Riders}$$

Where:

$CAP	=	total annual capital cost
$OP	=	total annual operating cost
TT Savings	=	travel time savings
Riders	=	systemwide linked transit trips

While the cost elements of the formula are fairly straightforward estimates, the calculation of travel time savings and net additional riders are less straightforward. The Central Transportation Planning Staff (CTPS) regional network computer model was used to generate the required net travel time savings and the net additional number of linked trips. These estimates were made at the regional level and reflect any travel changes anywhere in the system that are attributable to the differences among the alternatives.

6.4.1.2 User Benefit Index

The user benefit index that relates the costs of building and operating an alternative with the user benefits accruing from that alternative is as follows:

$$\text{User Benefit Index} = \frac{\Delta\$CAP + \Delta\$O\&M}{\Delta User\ Benefits}$$

Where:

$CAP	=	total annual capital cost
$O&M	=	total annual operating and maintenance cost
User Benefits	=	user price of transit travel (fares) converted to hours plus time (waiting, riding, transferring) for existing and new riders

As for the new trip index, the Bus/TSM Alternative serves as the point of comparison for the user benefit index. An alternative's capital and operating and maintenance costs are divided by the user benefits measured in hours of time saved to estimate the cost per hour saved relative to the Bus/TSM Alternative.

6.4.2 Cost-Effectiveness Results

The resulting indices of cost-effectiveness are shown for the Transitway Alternatives in Table 6-11 for the 2010 high and lower growth scenarios.

The new trip index results show that the Full Build Alternative would achieve the best cost-effectiveness in both the lower and high growth scenarios. The Full Build Alternative achieves a somewhat better new trip index than the MOS-1 Alternative, despite the substantial capital cost of the tunnel segment to Boylston Station. The additional ridership resulting from connections to the Green and Orange Lines at Boylston and Chinatown Stations adds substantially to the number of new riders attracted to the Full Build Alternative in comparison to the less extensive MOS Alternatives.

TABLE 6-11: COST-EFFECTIVENESS INDEX RESULTS*

Alternative	New Trip Index ($/new trip)		User Benefit Index ($/hour)	
	Lower Growth	High Growth	Lower Growth	High Growth
MOS-1	12.97	7.31	21.30	12.12
MOS-2	15.65	8.68	25.32	14.04
Full Build	10.11	6.84	15.55	10.47

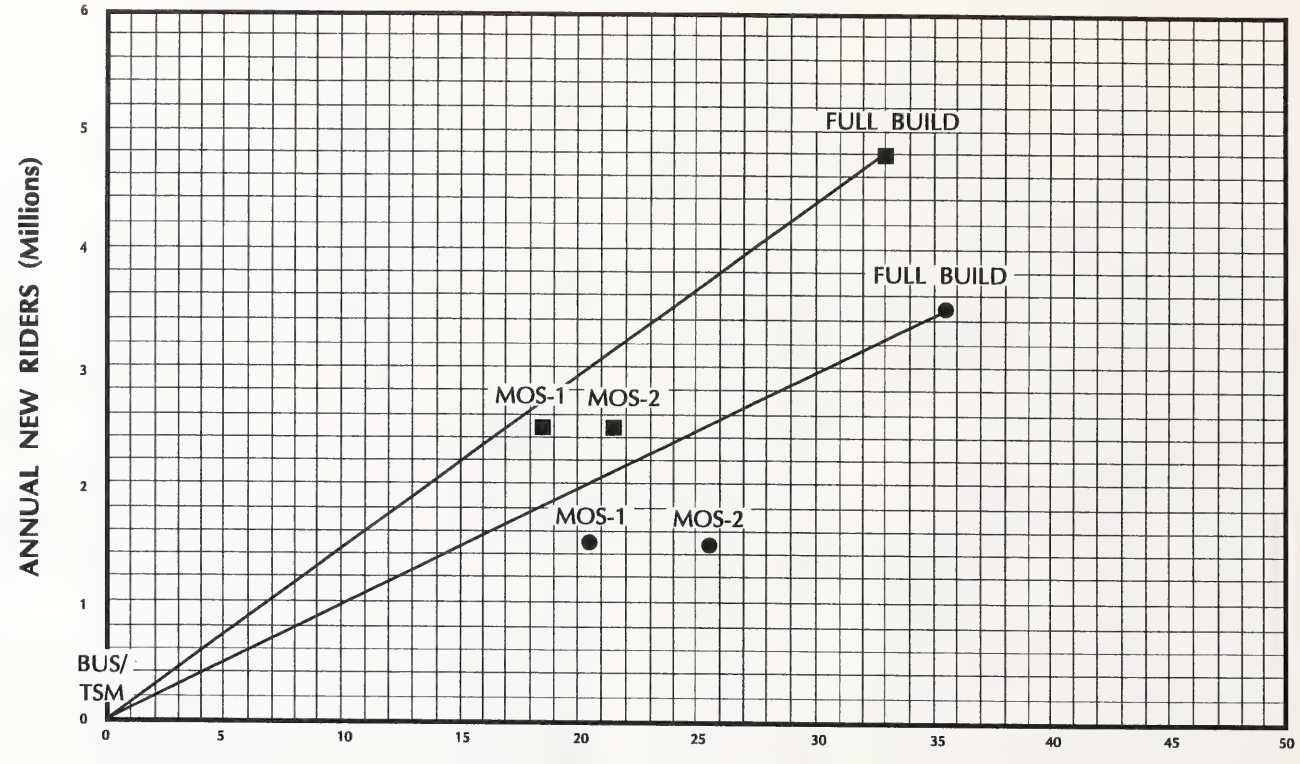
* ***Calculation of cost-effectiveness indices reflect a discount rate of 7 percent, as recommended by the FTA.***

The MOS-2 Alternative would be the least cost-effective of the alternatives. Since no rider benefits are attributed to the tunnel section between Fan Pier and the World Trade Center provided by the MOS-2 Alternative relative to the MOS-1 Alternative, the additional capital costs are overriding[4]. It should be noted that the major benefits of the extended tunnel in the MOS-2 Alternative — reduced surface traffic and the provision of high-platform enclosed boarding areas — are not benefits that can be fully captured in either the travel time savings or new riders component of the cost-effectiveness index. The index for MOS-2 compared with MOS-1 measures only the small savings that would be experienced by several thousand riders daily.

Comparing the new trip index estimates for the two growth scenarios, the impact of lower and higher levels of development on cost-effectiveness can be determined. As would be expected, cost-effectiveness improves with greater levels of development. At the high growth level, the indices for the MOS-1 and Full Build Alternatives are only ***47 cents*** per rider apart, with the Full Build the more cost-effective. At the lower growth level, the Full Build Alternative has an advantage of ***$2.86*** per rider. While it may seem counterintuitive to find the most capital-intensive Full Build Alternative outperforming the MOS-1 in cost-effectiveness particularly at the lower levels of development, there is a good reason for this result. The MOS-1 Alternative serves Green and Orange Line transfers on separate bus services, while the Full Build Alternative serves these riders on the same services as Red Line and South Station commuters. As a result, more of the MOS-1 service operates at policy headways when total demand for service drops. The result is higher operating costs per passenger for the MOS-1 Alternative. In addition, the presence of express buses in the high growth scenario for all action alternatives diminishes the difference in cost effectiveness.

These results can be displayed graphically in order to further illustrate the relative cost-effectiveness of the alternatives. Figure 6-5 plots the added costs of each alternative relative to the Bus/TSM Alternative. The slope of the line connecting the coordinates of an alternative with the origin is an indicator of the alternative's cost-effectiveness. The steeper the slope, the more cost-effective the alternative. In fact, the slope of the line is the inverse of the cost-effectiveness index. To identify the most cost-effective alternatives, the alternatives that lie highest and furthest to the left on the graph are connected. The resulting boundary, or "frontier," indicates the best project that can be formulated with increasing levels of

[4] It was an assumption of the ridership estimation methodology that the tunnel section between Fan Pier and the World Trade Center would not impact ridership.



ALTERNATIVE	LOWER GROWTH		HIGH GROWTH	
	RIDERS	COSTS	RIDERS	COSTS
BUS/TSM	0	$0.00	0	$0.00
MOS-1	1.58	$20.51	2.51	$18.33
MOS-2	1.58	$25.74	2.51	$21.78
FULL BUILD	3.50	$35.40	4.82	$33.00

LOWER GROWTH ●
HIGH GROWTH ■

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Fig. 6-5
Cost Effectiveness

investment. Those alternatives that are below and to the right of the frontier represent less cost-effective solutions to the transportation problem.

The user benefit indices also show the Full Build Alternative to be the most cost-effective in both growth scenarios. The MOS-1 and Full Build Alternatives are closest in cost-effectiveness in the high growth scenario and show a greater divergence in the lower growth scenario.

6.5 SUMMARY OF TRADE-OFFS BETWEEN ALTERNATIVES

The purpose of this section is to highlight the key differences among the alternatives based on the evaluation criteria discussed in the preceding sections. These differences are presented in terms of trade-offs among the discussed issues.

6.5.1 No Action versus Action Alternatives

The No Action Alternative includes existing and committed transportation facilities in conjunction with a minimal increase in existing transit services. Consequently, it would have the lowest cost among the alternatives considered. The No Action Alternative would not provide additional travel options nor would it improve access to the Piers area from downtown Boston and the regional corridors. Travel times would therefore not be reduced. The No Action Alternative would result in unacceptable levels of traffic congestion. Overall, this alternative would not support the economic development and transportation needs of the Piers area.

6.5.2 Bus/TSM versus Transitway MOS-1, MOS-2, and Full Build Alternatives

In comparing all of the action alternatives, the Bus/TSM Alternative would result in the lowest capital and operating cost outlays. While the Bus/TSM Alternative would increase travel options, it would not adequately reduce roadway congestion and could result in limitations on Piers area development. Deficiencies in the Bus/TSM Alternative are reflected by the fact that the MOS and Full Build Transitway Alternatives would further reduce daily Piers area auto trips by 3,000 and 5,100, respectively, as compared to the Bus/TSM Alternative.

The Bus/TSM Alternative can be viewed as an interim staging option that provides improved transit service to the Piers area while foregoing the substantial capital investment required for the Transitway Alternatives. The provision of on-street passenger facilities and a new bus storage and maintenance facility would still represent a significant capital investment in transit infrastructure in the Piers area. This course of action has an inherent risk due to the possibility that the TSM services would not be able to accommodate major development in the Piers area, with the result that development would be underserved by transit. Should the TSM services eventually become unable to meet the transit needs of the Piers area, it would be possible to then consider construction of the Underground Transitway. However, construction of the Transitway with much development already in place would likely result in extensive disruptions to utilities, traffic, and access to businesses in the Piers area. These factors, combined with the need to retrofit the Transitway tunnel into the depressed Central Artery alignment would result in significant increases in construction schedules and costs.

6.5.3 MOS versus Full Build Alternative

Of the three Transitway Alternatives, MOS-1 (South Station to Fan Pier) would require the least capital and operating funds. However, the MOS-1 Alternative would not offer the non-disruptive Piers area service expansion possibilities of the MOS-2 and Full Build Alternatives. The minimal MOS-1 tunnel would result in lower ridership (as compared to the Full Build Alternative) and greater on-street bus volumes, thereby perpetuating traffic congestion and a limitation on development in the Piers area in the high growth scenario. Irrespective of the development scenarios under consideration, the MOS-1 tunnel portal and "temporary" surface station located adjacent to the new Federal Courthouse at Fan Pier would interfere with pedestrian and vehicular movement at this location. Subsequent extension of the tunnel to the World Trade

Center would require extensive reconstruction and disruption at the Courthouse Station site and would also be disruptive along the entire length of New Northern Avenue.

However, given the uncertainties in the intensity and timing of Piers area development, the MOS-2 Alternative can be viewed as an acceptable staging option in which the investment in transit infrastructure can be made as demand develops. The MOS-2 Alternative also does not raise the near-term financial feasibility questions associated with the Full Build Alternative, particularly as concerns the present shortage of federal Section 3 new start funds. Both the MOS-2 and Full Build Alternatives would provide greater travel time savings and larger transit ridership than any of the other alternatives. The Full Build Alternative would incrementally outperform the MOS-2 Alternative in these categories, and it is the only alternative that would result in acceptable Piers area traffic conditions under both development scenarios. Consequently, the Full Build Transitway is the only alternative that would fully and consistently support the development and transportation objectives of the South Boston Piers/Fort Point Channel Transit Project.

6.6 DECISIONS REMAINING

Two key decisions remain to be made prior to implementation of the Full Build Transitway. The first is whether to underpin or take the New England Seafood Center. Construction of the Transitway tunnel beneath the Seafood Center would be feasible if the building is underpinned. However, in consideration of near- and long-term land use plans in the vicinity of the Center, which may entail its future taking, it may prudent to take the building as part of the Transitway Project. These plans include construction of a temporary New Congress Street around the Seafood Center as part of the CA/T Project traffic mitigation during construction program, and the future extension of New Congress Street which would require right-of-way acquisition from the Center.

To reflect a worst case scenario in terms of environmental and financial impacts, the MBTA has analyzed the consequences of taking the Seafood Center. The incremental cost of taking the Center is estimated at $10 million. These costs and the environmental impacts of the taking must be compared against any potential benefits of the taking. The primary benefit involves the elimination of a temporary New Congress Street.

The decision whether to take or underpin the Seafood Center will involve coordination with MHD, Massport, the City of Boston, and Center occupants. It is expected that these other interests, should they identify and justify sufficient cause to take the Center, will share in all costs associated with (1) relocation of Center occupants; (2) demolition of the existing structure; and (3) surface restoration of the parcel.

The second decision involves selection of a site for the Transitway storage and maintenance facility. One of two sites on the Massport parcel bounded by Summer Street, Pappas Way, West First Street, and E Street (refer to previous Figure 2-7) would be capable of accommodating the Transitway vehicle fleet during operation of both the initial implementation (MOS-2) and Full Build phases. These sites are referred to as Site A (on the corner of Summer Street and Pappas Way) and Site B (on West First Street between Pappas Way and E Street).

The site selection process involves the evaluation of disadvantages associated with each site. Specifically, given Site B's smaller size as compared to Site A, employee parking would need to be constructed on the facility's roof. This results in an incremental cost associated with Site B of $10 million. In addition, Site B is located further from the Transitway portal at D Street, resulting in increased deadheading and non-revenue service. On the other hand, Site A would require the taking of a portion of the Subaru overflow parking lot, which is a water dependent use as defined by Chapter 91 regulations. Thus, the ability of the MBTA to use Site A for a Transitway storage/maintenance facility will be subject to permitability under Chapter 91.

Site selection for the storage/maintenance facility will involve close coordination between the MBTA and Massport. It is expected that this decision will be made prior to further design of the facility.

Additional Information

APPENDIX A
Process Memorandum of Agreement

PROCESS MEMORANDUM OF AGREEMENT

WHEREAS, the Federal Transit Administration (FTA) has determined that the South Boston Piers/Fort Point Channel Transit Project will have an effect upon properties included in or eligible for inclusion in the National Register of Historic Places and has consulted with the Massachusetts State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation (Council) pursuant to 35 CFR Part 800, regulations implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470f); and

WHEREAS, the Massachusetts Bay Transportation Authority (MBTA), the project proponent, participated in the consultation and has been invited to concur in this Memorandum of Agreement (MOA);

WHEREAS, properties in the Fort Point Channel District, the Leather District, the Textile District, the Washington Street Theatre District, and Piano Row, and the Young Men's Christian Union, Boston Common, the Tremont Street Subway/Boylston Station and Headhouses, Russia Wharf Buildings, and South Station and Headhouse have been found to be significant and unavoidable resources under 36 CFR 800, as presented in Attachment 1, *Preliminary Findings of Effect on Historic Resources in the Vicinity of the South Boston Piers/Fort Point Channel Transit Project.*

NOW THEREFORE, the FTA, the Massachusetts SHPO, and the Council agree that the above undertakings shall be implemented in accordance with the following stipulations in order to take into account the effects on resources included or eligible for inclusion in the National Register of Historic Places.

STIPULATIONS

FTA will ensure that the following measures are carried out:

1. Historic American Building Survey (HABS)/Historic American Engineering Record (HAER) Recording

Prior to alteration of the properties listed below, HABS/HAER (National Park Service, Mid Atlantic Regional Office, 143 South Third Street, Philadelphia, PA, 19106; Ms. Tina LeCoff 215-597-6484) will be contacted to determine the level of documentation required to provide a permanent record of the properties. A list of the properties, with a summary of their National Register significance, will be forwarded to HABS/HAER. All documentation must be accepted by HABS/HAER and the Massachusetts SHPO prior to alteration of the properties.

This stipulation refers to the following list of properties:

- Fort Point Channel
- Russia Wharf Buildings
- South Station and Headhouse

- Textile Building
- Tremont Street Subway
- Boylston Station and Headhouses

2. Appointment of Project Conservator and Review of Design and Construction Specifications

A Project Conservator shall be appointed to the project design team by the MBTA to ensure that adverse construction effects on all historic properties listed in Attachment 1 are identified early in the project planning stages, and are either avoided, minimized, or mitigated through appropriate preliminary and final design solutions. The Project Conservator shall be appointed in the preliminary design phase of the project.

The Project Conservator's responsibilities shall include overseeing the development of measures for monitoring and mitigating the adverse effects of construction on standing historic properties. These mitigation measures shall be included as part of the construction specifications.

The MBTA will afford the SHPO, in consultation with the Boston Landmarks Commission (BLC), an opportunity to review and approve the Project Conservator's job description, qualifications, and ongoing responsibilities, and to review and approve the preliminary and final design of construction specifications.

The Project Conservator appointed for the transit project will coordinate activities designed to protect buildings with the Project Conservator for the Central Artery/Tunnel Project.

3. Appointment of Architectural Firm with Experience with Historic Preservation and Review of Changes

An architectural firm with experience with historic preservation shall be appointed to the project design team by the MBTA. Such a firm would assist in the design of building elements associated with the project that affect historic resources.

FTA will afford the SHPO, in consultation with the BLC, an opportunity to review and approve the architectural firm's qualifications and scope of work, and to review and approve the preliminary and final design for such elements.

4. Reconstruction of Granite Bulkheads Walls at Fort Point Channel

The granite bulkheads walls on either side of the Fort Point Channel at the transit tunnel crossing points shall be reconstructed in such a manner as to ensure that the existing appearance and function of the bulkheads are maintained. The walls would be measured and photographed, and the stones marked, removed, and stored during construction. Samples of the existing mortar

would be collected and analyzed. After construction of the tunnel, the bulkhead walls would be rebuilt on a suitable foundation with appropriate backfill in the same positions as before, with mortar matching the existing in composition and color. All work shall meet the Secretary of the Interior's Standards for Rehabilitation of Historic Structures.

5. Alterations to Boylston Station

The interior of Boylston Station shall be rehabilitated following construction of the transit project in conformance with the Secretary of the Interior's Standards for Rehabilitation of Historic Structures.

6. Identification and Protection of Archaeological Resources

FTA, in consultation with the SHPO, shall ensure that an archaeological survey of the project is conducted in a manner consistent with the Massachusetts State Archaeologist's permit regulations (950 CMR 70) and the Secretary of the Interior's *Standards and Guidelines for Identification* (48 FR 44720-23) and take into account the National Park Service publication, *The Archeological Survey, Methods and Uses*, and the Advisory Council on Historic Preservation publications *Consulting About Archeology Under Section 106*, and *Treatment of Archeological Properties: A Handbook*. The survey shall be conducted in consultation with the SHPO. A report of the survey, meeting the standards of the SHPO, shall be submitted to the SHPO for their review and comment within thirty (30) days of receipt.

FTA shall evaluate properties identified through the survey in accordance with 36 CFR 800.4(c). If the resources are determined to be significant and eligible for listing in the National Register, the FTA and the MBTA shall consult with the SHPO to determine whether any project effects can be prudently or feasibly avoided, minimized, or mitigated pursuant to the procedures in 36 CFR 800.5(e) and 800.9.

FTA shall ensure that a protocol is developed in consultation with the SHPO to avoid and protect any human burials identified during any stage of the undertaking. The protocol shall include adequate measures to identify human burials by a professional archeaological team, to contact and consult with the Massachusetts State Archaeologist or her designee, and to provide interested parties, next-of-kin, descendants, or affiliated groups the opportunity to consult and comment on the treatment of human burials. Human burials identified during any stage of the undertaking shall be treated in accordance with Massachusetts General Laws Chapter 7, § 38A; Chapter 9, §§ 26A and 27C; Chapter 38, §6B; Chapter 114, § 17; Chapter 272, §§ 71 and 73; and the Native American Graves Protection and Repatriation Act (P.L. 101-601; 25 U.S.C. 3001-3013; 104 Stat. 3048-3058) ("burial laws"). FTA and the MBTA shall consult with the SHPO to determine whether any project effects on human burials can be prudently or feasibly avoided, minimized, or mitigated pursuant to the procedures in 36 CFR 800.5(e) and 800.9, and in the above-referenced burial laws, taking into account the views of any interested parties, next-of-kin, descendants, or affiliated groups.

Should mitigation be proposed for any historic properties or human burials, FTA shall ensure that a data recovery plan (DRP) is developed in consultation with the SHPO, and FTA shall take into account the views of any interested parties, next-of-kin, descendants, or affiliated groups. The DRP shall be consistent with the standards and guidelines outlined in 950 CMR 70 and the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation* (48 FR 44716-42), and take into account the Advisory Council on Historic Preservation publications *Consulting About Archeology Under Section 106*, and *Treatment of Archeological Properties: A Handbook*. It shall specify, at a minimum:

a) the property or properties where the data recovery is to be carried out;
b) the research questions to be addressed through the data recovery with an explanation of their relevance and importance;
c) the methods to be used, with explanation of their relevance to the research questions;
d) the methods to be used in analysis, data management, and dissemination of data, including a schedule;
e) the proposed manner and schedule for disposition of recovered materials and records consistent with 36 CFR Part 79;
f) proposed methods for involving the interested public in the data recovery;
g) proposed methods for disseminating the results of the data recovery to the interested public;
h) proposed methods by which interested parties, next-of-kin, descendants, or affiliated groups will be kept informed of the work and afforded the opportunity to participate;
i) a proposes schedule for the submission of progress, draft, and final reports to the SHPO for review and approval.

The DRP shall be submitted to the SHPO, the Advisory Council for Historic Preservation, and any interested parties, next-of-kin, descendants, or affiliated groups for review and comment. Unless the SHPO or the Council objects within thirty (30) days, FTA shall ensure that the DRP is implemented.

7. Unidentified Historic Properties and Archaeological Resources

While FTA has made a good faith effort to identify historic properties and archaeological resources during the initial project planning process, additional previously unidentified historic properties and archaeological resources may be discovered, which may be affected by the project. In these instances, FTA and the SHPO shall apply the National Register criteria of eligibility and consult pursuant to 36 CFR 800.4.

8. Joint Development Guidelines

a. Potential adverse effects (as defined in Section 800.3(b) of the Council's Regulations, "Protection of Historic and Cultural Properties" [36 CFR Part 800]) on historic properties listed in Attachment 1 resulting from the development of surface elements associated with the transit project (kiosks, catenary and supports, ventilation structures, and surface street improvements) and with as yet unidentified future joint development shall be avoided, minimized, or mitigated through appropriate design. Design guidelines will be developed by the MBTA in consultation with the Massachusetts SHPO, BLC, and other interested groups, for joint development affecting such properties.

b. Preliminary and final design and construction specifications for potential future joint development ventures, as they affect historic properties described in Attachment 1, will be reviewed and approved by the Massachusetts SHPO in consultation with BLC.

9. Review of Submitted Materials

Within 30 days of receipt of material requiring review, comment and/or approval by the SHPO, the SHPO shall notify the MBTA in writing of its approval of said material or, if the material is not approved, of the specific deficiencies in the material. Failure by the SHPO to respond within 30 days of receipt of any material or document from the MBTA shall be deemed to constitute full approval of such documents under the stipulations herein noted.

10. Amendment and Resolution of Disputes

a. Should the SHPO object within 30 days to any plans or specifications provided pursuant to this MOA, the FTA and the MBTA shall consult with the SHPO to resolve the objection. If the FTA determines that the objection cannot be resolved, the FTA and the MBTA shall forward all documentation relevant to the dispute to the Council and request an amendment to this MOA. Within 30 days after receipt of all pertinent documentation, the Council's Executive Director will either:

1. Provide the FTA with recommendations, which the FTA shall take into account in reaching a final decision regarding the dispute, or

2. Notify the FTA that it will comment pursuant to 36 CFR 800.6.

b. Any time during implementation of the measures stipulated in this MOA, should an objection to any such measure be raised by a local government or a member of the public, the FTA and the MBTA shall take the objection into account and consult as needed with the objecting party, the SHPO, or the Council to resolve the objection.

11. Separability from Central Artery/Tunnel Project MOA

No stipulations in this MOA shall affect stipulations agreed upon in the MOA signed for the Central Artery/Tunnel Project.

Execution of this MOA and implementation of its terms evidence that the FTA has afforded the Council an opportunity to comment on the proposed construction of the South Boston Piers/Fort Point Channel Transit Project and its effect on historic resources within the project limits; and that the FTA has taken into account the effects of the undertakings on historic properties.

The FTA will ensure that the stipulations incorporated in this MOA will be carried out by the MBTA in compliance with 36 CFR 800, regulations implementing Section 106 of the National Historic Preservation Act (16 U.S.C. 470f).

ATTACHMENT 1

PRELIMINARY FINDINGS OF EFFECT ON HISTORIC RESOURCES
IN THE VICINITY OF
THE SOUTH BOSTON PIERS/FORT POINT CHANNEL TRANSIT PROJECT

Historic Districts and Properties	Historic Status	Potential Impact	
		MOS-2	Full Build
South Boston Piers/Fort Point Channel District			
Fort Point Channel District	NRD-E	AEs	AEs
granite bulkheads		AEd	AEd
51 Sleeper Street		AEs	AEs
44-54 Farnsworth Street		AEs	AEs
41-46 Farnsworth Street		AEs	AEs
49-54 Farnsworth Street		AEs	AEs
42-56 Pittsburgh Street		AEs	AEs
41-47 Pittsburgh Street		AEs	AEs
51 Pittsburgh Street		AEs	AEs
44-48 Stillings Street		AEs	AEs
47-49 Stillings Street		AEs	AEs
Commonwealth Pier Five	NR	NE	NE
Fish Pier	NR-E	NE	NE
	NR-DOE	NE	NE
*Northern Avenue Bridge			
Chinatown/Midtown District			
Leather District	NRD	AEs	AEs
Hotel Essex, 687-95 Atlantic Ave.		AEs	AEs
705-13 Atlantic Avenue		AEs	NE
Boston Hide and Leather, 20-24 East Street		AEs	AEs
66-86 Lincoln Street		AEs	AEs
Textile District	NRD	NE	AEs
Wentworth Building, 90-100 Chauncy Street		NE	AEs
Textile Building, 89-99 Chauncy Street		NE	AEs

PRELIMINARY FINDINGS OF EFFECT ON HISTORIC RESOURCES
IN THE VICINITY OF
THE SOUTH BOSTON PIERS/FORT POINT CHANNEL TRANSIT PROJECT

Historic Districts and Properties	Historic Status	Potential Impact	
		MOS-2	Full Build
Frost Building, 105-11 Chauncy Street		NE	AEs
Chauncy House, 115-17 Chauncy Street		NE	AEs
62-72 Essex Street		NE	AEs
76-78 Essex Street		NE	AEs
73-79 Essex Street		NE	AEs
Pelham Building, 81-83 Essex St.		NE	AEs
Kingston Building, 105-7 Essex St.		NE	AEs
80-86 Kingston Street		NE	AEs
88-100 Kingston Street		NE	AEs
Auchmuty Building, 104-22 Kingston Street	LLp	NE	AEs
Kingston Building, 121-27 Kingston Street		NE	AEs
129-131 Kingston Street		NE	AEs
Washington Street Theatre District	NRD	NE	AEs
Paramount Theater, 549-63 Washington Street	LL	NE	AEs
*Opera House, 537-41 Washington Street	LL	NE	NE
Piano Row	NRD	NE	AEs
Hotel Touraine, 62 Boylston Street		NE	AEs
Little Building, 80 Boylston Street		NE	AEs
Colonial Building/Theater, 96-104 Boylston Street	LLp	NE	AEs
177 Tremont Street		NE	AEs
Oliver Ditson Building, 178-79 Tremont Street		NE	AEs
Boston Edison Electric, 180-82 Tremont Street		NE	AEs
Masonic Lodge, 183-86 Tremont Street		NE	AEs
Young Men's Christian Union	NR, LL	NE	AEs
Boston Common	NHL, LL	NE	AEc

PRELIMINARY FINDINGS OF EFFECT ON HISTORIC RESOURCES IN THE VICINITY OF THE SOUTH BOSTON PIERS/FORT POINT CHANNEL TRANSIT PROJECT

Historic Districts and Properties	Historic Status	Potential Impact	
		MOS-2	Full Build
Tremont Street Subway	NHL	NE	AEs
Tremont Street Subway		NE	AEs
Boylston Station (underground)		NE	AEa
Boylston Station headhouses		NE	AEs
*Boylston Building, 2-22 Boylston Street	NR, LL	NE	NE
*Boston Edison Electric Illuminating Company, Company, 25-39 Boylston Street	NR	NE	NE
	NRD	NE	NE
Liberty Tree District			
*Liberty Tree Building, 628-36 Washington Street	LL	NE	NE
	LL	NE	NE
*Emerson/Majestic Theatre, 219-21 Tremont Street			
South Station Area			
Russia Wharf Buildings	NR	AEs	AEs
South Station Headhouse	NR	AEs	AEs
South Station	NR-DOE	AEs	AEs

Notes:
NR: historic property listed in the National Register of Historic Places
NRD: historic district listed in the NR
NR-E: eligible for listing in the NR
NR-DOE: determination of eligibility for listing in the NR
NHL: National Historic Landmark
LL: local landmark
LLp: local landmark, petitioned
NE: no effect
NAE: no adverse effect
AE: potential adverse effect

a: Alteration to historic interior
c: Temporary intrusion of construction operations
d: Demolition and reconstruction
s: Potential settlement resulting from tunnel construction

* Outside the study corridor, but of concern to the Massachusetts Historical Commission and Boston Landmarks Commission.

ADVISORY COUNCIL ON HISTORIC PRESERVATION

By: _____ Date: _____
Executive Director

U.S. FEDERAL TRANSIT ADMINISTRATION

By: _____ Date: 12/10/93
Regional Administrator, Region I

MASSACHUSETTS HISTORICAL COMMISSION

By: _____ Date: 12/9/93
State Historic Preservation Officer/
Executive Director

Concur:

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

By: _____ Date: 12/2/93
General Manager

BOSTON LANDMARKS COMMISSION

By: _____ Date: 12/9/93
Executive Director

Approved as to form:

By: _____ Date: 12/2/93
MBTA General Counsel

APPENDIX B
Distribution List

DISTRIBUTION LIST

1. FEDERAL AGENCIES

Advisory Council on Historic Preservation

Department of the Interior

- Office of the Secretary
- National Park Service
- Fish and Wildlife Service

Federal Emergency Management Agency

National Marine Fishery Service

U.S. Army Corps of Engineers

U.S. Coast Guard

U.S. Department of Agriculture

U.S. Department of Commerce

U.S. Department of Housing and Urban Development

U.S. Department of Transportation

- Office of the Secretary
- Federal Transit Administration
- Federal Highway Administration

U.S. Environmental Protection Agency

U.S. Department of Energy

U.S. Department of Health and Human Services

2. STATE AGENCIES

Department of Environmental Management

Department of Environmental Protection

- Division of Wetlands and Waterways Regulation
- Division of Air Quality Control
- Division of Water Pollution Control

Distribution List (continued)

Department of Fisheries, Wildlife & Environmental Law Enforcement

Department of Food & Agriculture

Department of Public Utilities

Executive Office of Communities and Development

Executive Office of Environmental Affairs

- Secretary
- MEPA Unit
- Coastal Zone Management

Executive Office of Public Safety

Executive Office of Transportation and Construction
- Secretary
- Massachusetts Bay Transportation Authority
  - General Manager
  - Executive Director, MBTA Advisory Board
  - Board of Directors
- Massachusetts Highway Department
  - Commissioner
  - I-90/I-93 Project Office
- Transportation Building Library*

Massachusetts Historical Commission

Massachusetts Port Authority

Massachusetts Water Resources Authority

Massachusetts Turnpike Authority

3. REGIONAL AGENCIES

Metropolitan Area Planning Council

Distribution List (continued)

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4. LEGISLATORS

U.S. Congress

Senator Edward M. Kennedy
Senator John F. Kerry
Congressman Joseph Moakley

Area Elected Officials

Representative Paul J. Gannon
Senator William M. Bulger
Councillor James M. Kelly

State Joint Committee on Transportation

Representative Stephen J. Karol
Senator Robert Havern, Chairman

5. LOCAL AGENCIES AND OFFICIALS

City of Boston - Clerk

Boston Conservation Commission

Boston Public Library

Main Library (666 Boylston Street, Boston)*
South Boston Branch (646 East Broadway, South Boston)*

Boston Redevelopment Authority*

Boston Transportation Department

Boston Parks and Recreation Department

Boston Landmarks Commission

Boston Environment Department

Economic Development & Industrial Corporation

Boston Department of Public Works

* Libraries where FEIS/FEIR is publicly available during regular business hours.

APPENDIX *C*
List of Preparers

LIST OF PREPARERS

1. FEDERAL TRANSIT ADMINISTRATION

Donald J. Emerson
Director, Planning Analysis and Support Division, Office of Planning, Washington, D.C.

Mr. Emerson supervises the team of project managers and technical specialists that provides Federal Transit Administration assistance and review during the preparation of the Environmental Impact Statement. He holds a Master's degree in Urban Affairs and a Bachelors degree in Civil Engineering.

Mary Beth Mello
Deputy Administrator, Region I, Cambridge, Massachusetts

Ms. Mello supports the Regional Administrator in the delivery and management of FTA programs in the six-state New England Region. She holds a Master's degree in Business Administration and a Bachelors degree in Urban Studies.

R. Max Vigil
Chief, Office of Program Development, Region I, Cambridge, Massachusetts

Mr. Vigil manages the program development effort in the six-state New England Region. He holds a Masters degree in Urban Planning, a Master's degree in Public Administration, and a Bachelors degree in Sociology.

Sheila A. Cohen
Community Planner, Office of Planning, Washington, D.C.

Ms. Cohen is responsible for technical assistance and review of the environmental impact statement. she holds a Bachelor's degree in Geography.

2. MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

Nancy Tekirian Polcari
Assistant Director of Design and Construction

Ms. Polcari is responsible for the management of all project managers in the Massachusetts Bay Transportation Authority's Construction Department for the Central Section. Her current projects include the South Boston Piers Transit Project, South Station Transportation Center, Operations Control, Aquarium Station, Haymarket Station, Airport Station, South Boston Piers Improvement Project, and coordination issues with the Massachusetts Highway Department on the Central Artery (I-93)/Third Harbor Tunnel (I-90) Project, and with Amtrak on the Northeast Corridor. Ms. Polcari holds a Bachelor's degree in Architectural Engineering.

Mary R. Ainsley
Project Manager, Design and Construction — Central

Ms. Ainsley's responsibilities include the project management for the design and construction associated with the South Boston Piers Transit Project and the South Boston Piers Improvement Project. She is also responsible for the coordination of the environmental consulting team for the South Boston Piers Transit Project. Ms. Ainsley holds a Bachelor of Science degree in Civil Engineering.

David W. Ryan
Project Manager, Design and Construction — Central

Mr. Ryan has fourteen years of experience with the Massachusetts Bay Transportation Authority, the last year of which was spent as a project manager for design and construction associated with the South Boston Piers Transit Project. He holds an Associate's degree in applied science and is completing a Bachelor's degree in construction management.

Andrew D. Brennan
Manager of Environmental Affairs

Mr. Brennan is responsible for the implementation, management, and coordination of the Authority's environmental policies, programs, and procedures. He also acts as liaison with all environmental and regulatory agencies to ensure full compliance with all federal, state, and local environmental laws. Mr. Brennan holds a Bachelor's degree in Civil Engineering and a Master's degree in Political Studies.

3. CENTRAL TRANSPORTATION PLANNING STAFF

Karl H. Quackenbush
Deputy Director, Operations

Mr. Quackenbush directed all ridership and associated forecasting for the project. He established the conceptual and technical approach to the forecasting and supervised its conduct in CTPS's Transportation Systems Analysis group; and he established linkage between ridership and traffic forecasting models and provided inputs to the latter. Mr. Quackenbush also coordinated on the modeling and non-modeling matters with the client and consultant team. In addition, he wrote the EIS/EIR section on forecasting. Mr. Quackenbush holds a Bachelor of Arts degree and a Master of City and Regional Planning degree.

M.S. Vijaya Kumar Mahal
Manager, Transportation Systems Analysis Group

Mr. Mahal was responsible for coding different transit alternatives; developing all the necessary model inputs; running the UTPS transit model to estimate transit ridership, fare revenue, travel time savings, etc., for each alternative; responding to consultant's specific data needs; and finally, analyzing and summarizing the model results from the computer runs. Mr. Mahal has a Bachelor's degree in Civil Engineering, a Master's degree in Transportation Engineering, and a Ph.D. in Civil Engineering.

4. URS CONSULTANTS, INC.

William L. Gallagher, P.E.
Vice President, URS Consultants, Inc.
Project Manager

Mr. Gallagher served as project manager for the project team and oversaw preparation of the FEIS. He managed conceptual engineering for the project's DEIR and was Project Manager of the I-90/I-93 Central Artery Coordination Project (Phases 1 and 2) for the Massachusetts Bay Transportation Authority. Mr. Gallagher holds a Bachelor's degree in Civil Engineering.

Richard A. Carpenito, P.E.
Assistant Project Manager

Mr. Carpenito's responsibilities included assistance with coordination and preparation of the Response to Comments Appendix, coordination and preparation of the Design Drawings Appendix, assistance in development of mitigation measures, and assistance with preparation and editing of the FEIS. Mr. Carpenito holds a Bachelor's degree in Civil Engineering.

Diane Gray
Transportation Planner

Ms. Gray assisted in the preparation of the Response to Comments Appendix, and preparation and editing of the FEIS. Ms. Gray holds a Master of Science degree in Urban Planning and a Bachelor of Arts degree in International Relations.

Kamran Asdigha
Senior Transportation Engineer

Ms. Asdigha served as project transportation engineer for the FEIS. His work included traffic analysis for twenty-five intersections plus volume reduction analysis and volumes and speeds by link study for air quality and noise receptor location analysis. He holds a Master's degree in Transportation Engineering and a Bachelor's degree in Civil Engineering.

Marci Snyder
Graphics Manager

Ms. Snyder was responsible for the development and preparation of all graphics in the FEIS, and of graphics in the technical reports associated with the DEIS. She also coordinated the printing of these documents. She holds a Bachelor's degree in Graphic Design.

Allen R. Muhic
Air Quality and Noise Analyst

Mr. Muhic prepared the air quality and noise and vibration sections of the FEIS and the Social, Economic, and Environmental Impact Assessment Methods and Results Report for the DEIS. He has eighteen years of experience in preparing environmental documents for, and assessing the impacts of, transportation projects, including mass transit projects, highways, and airports. Mr. Muhic's experience includes use of

all widely accepted air quality and noise impact models and technical methodologies. He holds Bachelor's degrees in Civil Engineering and in Life Sciences.

Lori Ferrante
Word Processor

Ms. Ferrante's responsibilities included typing and editing of the FEIS. She holds a Bachelor's degree in Marketing.

5. MULTISYSTEMS, INC.

James A. Wensley
Technical Manager

Mr. Wensley was principal author of the Transportation Impacts FEIS chapter and Results Report. He has eleven years of professional experience and has been involved in the South Boston Piers/Fort Point Channel Transit Project since the initial feasibility study in 1986. He has a Bachelor's degree in Civil Engineering (Transportation Systems).

Larry S. Englisher
Director of Transit Planning

Mr. Englisher served as project manager for Multisystems' efforts on the FEIS, as well as on the prior alternatives analysis and feasibility study. He has twenty years of experience in the transportation planning field and holds a Master's degree in Civil Engineering (Transportation Systems).

Ronald E. Downing
Senior Transportation Analyst

Mr. Downing played a key role in the definition of alternatives, development of service plans, and the modeling and estimation of operating and maintenance costs. He has over eight years of professional experience and holds a Master's degree in Transportation Planning.

6. RIZZO ASSOCIATES, INC. WITH THE PUBLIC ARCHAEOLOGY LABORATORY, INC.

Elizabeth Levin
Director, Socioeconomic and Environmental Evaluations

Ms. Levin was responsible for the technical oversight and quality control for the socioeconomic and environmental evaluations for the DEIS and FEIS. She has many years of experience in the management of complex multi-disciplinary environmental studies for transportation, water, wastewater, and development projects. She holds a Master's of Urban Affairs degree and a Master's of Business Administration degree.

List of Preparers (continued)

Andrew D. Magee
Project Manager, Environmental Services

Mr. Magee was responsible for the management of those sections of the FEIS evaluating the impact of the project on the natural environment, and in particular the waters of Boston Harbor. This work included the assessment of the quality, quantity, and disposal options for the anticipated dredged and excavated materials generated by the project. Mr. Magee holds a Master of Arts degree in Geology and a Bachelor of Arts degree in Geology.

Elizabeth Martin
Project Geologist

Ms. Martin was responsible for the assessment of sediment quantity and quality within the alternative alignments and a review of disposal or reuse options for contaminated alignment sediments. She has conducted numerous site investigations for the presence of hazardous materials, and has supervised the remediation of contaminated sites. She holds a Master of Science degree in Geological Sciences and a Bachelor of Arts degree in Geology.

Amy H. Braiwa
Wetlands Scientist

Mr. Braiwa conducted the assessment of wetland and water resources along the alternative alignments, in particular as they approached and crossed the Fort Point Channel and the Boston Inner Harbor. She has conducted many such wetland/waterway evaluations of fresh and saltwater environments in New England, New York, and New Jersey. She holds a Master of Science degree in Botany and Wetland Science and a Bachelor of Arts in Botany.

Brian T. Butler
Project Geologist

Mr. Butler conducted an assessment of the suitability of project excavate for landfill reuse or disposal. This included a review of available landfill sites and a review of reuse and disposal options being considered for the Central Artery/Third Harbor Tunnel Project. He holds a Bachelor of Science degree in Geology.

Deborah C. Cox
The Public Archaeology Laboratory, Inc.
Project Manager, Cultural Resource Management Services

Ms. Cox was responsible for coordination of historic and archaeological investigations associated with the FEIS. As an archaeologist and senior administrator, she has managed numerous complex projects involving prehistoric and historic archaeology and historic architectural documentation. Ms. Cox holds a Master of Arts degree in Anthropology and a Bachelor of Arts degree in History and Anthropology. She also holds certificates in Preparing Agreement Documents and Federal Projects and Historic Preservation Law.

James C. Garman
Principal Investigator

Mr. Garman conducted the Supplemental Phase Ia Archaeological Reconnaissance Survey. Mr. Garman has his Bachelor of Arts degree in Archaeology and a Master's in Anthropology, and is currently a doctoral candidate.

Maureen A. Cavanaugh
Preservation Planner

Ms. Cavanaugh acted as project manager for the Supplemental Phase Ia Archaeological Reconnaissance Survey. She holds a Bachelor of Fine Arts degree, and a Master's degree in Urban Planning.

7. CAMBRIDGE SYSTEMATICS, INC.

Laurie L. Hussey
Associate

Ms. Hussey was the principal author of the FEIS and earlier DEIS. She was responsible for managing and coordinating the technical analyses and assessments comprising these documents, and performed land use and other planning and financial analyses. She was project manager of the project's Transit Financing Study and a senior planner for the DEIR. Ms. Hussey holds a Bachelor's degree in English/Communication and a Master's degree in Information Resources Management.

William L. Schwartz
Associate

Mr. Schwartz was involved in organizing the responses to comments on the DEIR and DEIS/SDEIR. This included assigning comments to individual team members and preparing responses to several transportation-related comments. Mr. Schwartz holds a Master's degree in Transportation.

Debby Carr
Urban Planner

Ms. Carr was involved in updating future development plans in the affected districts, including the South Boston Piers/Fort Point Channel District, South Station, Chinatown/Leather District, and Midtown District. She holds a Master's degree in City and Regional Planning.

William E. Craven
Senior Transportation Planner

Mr. Craven assisted in the financial analysis conducted for the South Boston Piers Transit Project. He holds a Bachelor of Science degree in Civil Engineering.

Jocelyn K. Shepard
Administrative Assistant

Ms. Shepard's responsibilities included copy editing chapters of the FEIS/FEIR and indexing the document. she has a Bachelor's degree in Communications.

John R. Curl
Intern

Mr. Curl's responsibilities included copy editing chapters of the FEIS/FEIR and assisting in a number of technical analyses. He received a Bachelor of Arts degree in Economics and is currently working towards a Master's degree in Business Administration.

8. BOSTON AFFILIATES, INC.

Dorothea Hass
Neighborhoods and Parklands Coordinator

Ms. Hass was responsible for the preparation of the neighborhood and parkland sections of the FEIS, and associated technical reports including the Section 106 Documentation/Section 4(f) Evaluation. Ms. Hass has over sixteen years of experience in environmental documentation and analysis on infrastructure projects such as commuter rail and transit rehabilitation, highway construction, and a dam and irrigation development. She is co-founder of Boston Affiliates and holds a Master's degree in Political Science.

Stanley Moss
Historic Resources Coordinator

Mr. Moss prepared the historic resources portions of the FEIS, including the Section 106 Documentation/Section 4(f) Evaluation. Mr. Moss has more than twenty years of experience as a consultant in city planning, environmental planning, and historic preservation. He holds Master's degrees in City Planning and in History/Archival Methods.

9. CASENDINO & COMPANY

Anthony B. Casendino, FASLA

Mr. Casendino was responsible for developing the visual and aesthetic impacts of the transit alternatives. His work included the investigation on the urban design of the proposed egress structures, portals, catenary wires and supports, streetscape elements, and maintenance facility. In addition, Mr. Casendino provided graphic assistance in preparing community, agency, and public presentation documents. He has over twenty-five years of professional experience and holds a Bachelor's degree in Architecture.

Cara S. Casendino

Ms. Casendino was responsible for documenting the visual and aesthetic impacts of the surface routing for the articulated trolley bus technology. This included site visits as well as research into other locations

on the vehicle/technology use, both locally and nationally. She also assisted in developing graphic and written material for use in community, agency, and public presentations. She has over twenty years of professional experience and holds a Bachelor's degree in Education.

APPENDIX D
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GLOSSARY

AA/DEIS	Alternatives Analysis/Draft Environmental Impact Statement
ACOE	Army Corps of Engineers
ADA	Americans with Disabilities Act
AGT	Automated Guideway Transit
APCC	Air Pollution Control Commission
AQCR	Air Quality Control Region
BLC	Boston Landmarks Commission
BMIP	Boston Marine Industrial Park
BRA	Boston Redevelopment Authority
BTD	Boston Transportation Department
BTPR	Boston Transportation Planning Review
BTU	British Thermal Units
BWC	Boston Wharf Company
CAAA	Clean Air Act Amendments (of 1990)
CBD	Central Business District
CHABA	Committee on Hearing, Bioacoustics, and Biomechanics
CHART	Cross Harbor and Regional Transportation Alternatives
CO	Carbon Monoxide
CSO	Combined Sewer Overflows
CTPS	Central Transportation Planning Staff
CZM	Office of Coastal Zone Management
DBA	Decibel Scale (noise measure)
DEIS/SDEIR	Draft Environmental Impact Statement/Supplemental Draft Environmental Impact Report
DEP	Department of Environmental Protection
EDA	Economic Development Area
EDIC	Economic Development and Industrial Corporation
ENF	Environmental Notification Form
EOEA	Executive Office of Environmental Affairs
EPA	Environmental Protection Agency
FAR	Floor-to-Area Ratio
FEIR	Final Environmental Impact Report
FHWA	Federal Highway Administration
FPAC	Fort Point Artists Community
FTA	Federal Transit Administration
GSA	General Services Administration
HC	Hydrocarbons
HOV	High Occupancy Vehicle
IPOD	Interim Planning Overlay District
ISO	International Organization for Standardization
ISTEA	Intermodal Surface Transportation Efficiency Act
LOS	Level of Service
M.G.L.	Massachusetts General Laws
MAPC	Metropolitan Area Planning Council
Massport	Massachusetts Port Authority
MBTA	Massachusetts Bay Transportation Authority
MDPW	Massachusetts Department of Public Works

Glossary (continued)

MEPA	Massachusetts Environmental Protection Act
MER	Maritime Economy Reserve
MHC	Massachusetts Historical Commission
MHD	Massachusetts Highway Department
MOE	Measure of Effectiveness
MOS	Minimum Operable Segment
MPO	Metropolitan Planning Organization
NAAQS	National Ambient Air Quality Standards
NAC	Noise Abatement Criteria
NEPA	National Environmental Protection Act
NHPA	National Historic Preservation Act
NMHC	Non-methane Hydrocarbons
NO_2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	Oxides of Nitrogen
NPDES	National Pollution Discharge Elimination System
O&M	Operating and Maintenance
O_3	Ozone
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Biphenyls
PMT	Program for Mass Transportation
RCRA	Resource Conservation and Recovery Act
RTIP	Replacement Transit Improvement Project
SEL	Sound Exposure Level
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
TCLP	Toxicity Characteristic Leaching Procedure
TIP	Transportation Improvement Plan
TPH	Total Petroleum Hydrocarbon
TSM	Transportation System Management
TSP	Total Suspended Particulates
UTPS	Urban Transportation Planning System
VMT	Vehicle-Miles-Traveled
VOC	Volatile Organic Compound
WQC	Water Quality Certification

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